

**CLASS 423, CHEMISTRY OF INORGANIC COMPOUNDS****SECTION I - CLASS DEFINITION**

This is the generic class for:

1. Inorganic Compounds

2. Nonmetallic Elements

3. Processes . . . (a) Processes of producing or separating by a chemical reaction a product of 1. or 2. supra, (b) chemical reaction processes not elsewhere provided for, (c) processes of separating or purifying a gaseous mixture including a chemical reaction and (d) processes which are directed to extracting, leaching or dissolving a product of 1. or 2. supra from a mixture either, per se, or in combination with steps not otherwise provided for and for dissolving of such a product to make a water solution thereof.

**AMPLIFICATION OF CLASS SUBJECT MATTER**

This class provides for what is generally termed the field of inorganic chemistry. It includes inorganic compounds, nonmetallic elements and processes of producing the same involving a chemical reaction. The products are generally in a relatively pure state but may be a mixture with no other utility than as a source material for an inorganic compound or element. This includes metal compound products useful in metallurgical processes of obtaining free metals (see Subclass References to the Current Class, below).

A mixture of an inorganic compound or nonmetallic element with a preserving agent whose sole function is to prevent physical or chemical change of such compound or element is provided for in this class, unless the mixture is disclosed or claimed as having a function or utility provided for in the composition classification (see Subclass References to the Current Class, below). Also, processes of merely incorporating a preservative are included in this class.

The rules for determining class placement of the original reference (OR) for claimed chemical compositions are set forth in the class definition for compositions. See the (17) Note under LINES WITH OTHER CLASSES AND WITHIN THIS CLASS for additional information.

This class also provides for processes of separating or purifying a normally gaseous mixture by a chemical

reaction, unless the resulting mixture has a disclosed utility provided for in the composition classification.

This class is also the residual class for all chemical reactions not provided for elsewhere, e.g., a reactive process where no specific product compound is disclosed.

For this class, the nonmetallic elements are: the halogens including astatine, the inert gases, hydrogen, boron, carbon, silicon, nitrogen, phosphorus, oxygen, sulfur, selenium and tellurium.

This class is also the class for extracting, leaching or dissolving processes not provided for elsewhere (see Subclass References to the Current Class, below).

**SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS**

- (1) Note. An inorganic compound for this class must contain a nonmetallic element; intermetallic compounds, or union of metallic elements only are excluded and will be found in Class 420.
- (2) Note. Subclasses which recite nitrogen or hydrogen in their titles do not include the ammonium radical ( $\text{NH}_4^+$ ) within their definitions; the  $\text{NH}_4^+$  radical is considered to be, and is treated as, an entity or element, equivalent to Na, Ca, N, etc.
- (3) Note. When a radical is indicated in a subclass title, (e.g., sulfide, carbonate, phosphate, etc.), all forms thereof (i.e., the acid forms, such as  $\text{HSO}_3^-$ ,  $\text{HCO}_3^-$ ,  $\text{HPO}_4^{2-}$ ,  $\text{H}_2\text{PO}_4^-$ ) are also included within the definition, unless specifically stated otherwise. Generally, however, in the metal recovery area, subclasses 1+, only the radicals listed in the titles are involved and no other. For example, in subclass 36, "sulfating" means that only the sulfate ( $\text{SO}_4^{2-}$ ) radical is intended. In the remaining areas of the schedule all forms of the radical are generally intended.
- (4) Note. Use of a chemically reactive material, e.g., acid or base is considered to involve a chemical treatment for this class, unless there is evidence to the contrary or

where otherwise stated, (see subclass 210, reference to Class 95, for example).

- (6) Note. Processes of purification which involve oxidation or chemical conversions of impurities, as well as those processes wherein the compound sought to be purified is first converted into some other form or derivative from which it is reverted to the original compound are also considered to be chemical treatment.
- (7) Note. Processes of preparation of an inorganic compound or a nonmetallic element which include chemical treatment or preparation are classified in the appropriate compound or element subclass, unless a process subclass is specifically provided therefor under the compound or element subclass, even though combined with a purely physical operation precedent, subsequent, or both. However, a patent containing a claim to the product and a claim to the process of manufacture thereof, which process is indented under the product subclass, should be placed in the outdent (product subclass) and cross-referenced to the other. A claim to the product of making it is considered to be a product claim and should be classified in the appropriate product subclass and cross referenced to the process, if any.
- (8) Note. Processes of preparation or treatment of inorganic compounds and nonmetallic elements which involve only physical treatment except for extracting, leaching or dissolving, per se, are classified in 23, Chemistry: Physical Processes, subclasses 293+ unless specifically provided for in some other main class. When extracting, leaching or dissolving processes are combined with significant crystallization steps, see Class 23, Chemistry: Physical Processes, subclasses 295+. Also see Class 23, Chemistry: Physical Processes, subclasses 293, 294 and 306 thru 308 for extracting, leaching or dissolving which may be combined with physical steps therein provided for. When patents include claims to a physical process and also claims to the compound or element treated, the original patent is classified in Class 423 in the appropriate subclass providing for the compound or element and cross-referenced to the appropriate process subclass in Class 23.
- (9) Note. Varying the amount of water of crystallization or hydration is considered to involve a chemical reaction; merely changing from one crystalline form to another or from or to a non crystalline form is not considered to be a chemical reaction.
- (10) Note. The combination of a nominal molding step and a chemical reaction is properly classified in Class 423. See definition of Class 264 for examples of "nominal" molding steps.
- (11) Note. The combinations of a chemical reaction and magnetic separation is in Class 423.
- (12) Note. A compound having water of hydration or crystallization attached thereto is classified with the basic compound unless there is a specific subclass provided for the hydrated compound. In this respect, the water (H<sub>2</sub>O) is treated as a unit and the hydrogen and oxygen therein of themselves do not cause classification in the oxygen area (579+) or the hydrogen area (644+).
- (13) Note. A material or substance containing a metal or other element in a range of absolute values or mole ratios compared to another metal or other element, (e.g., 1.7-3.5 parts, mole ratio of M to X in the range of 1.1-3.7, etc.), will be considered proper for a composition class; if the metal or other element is present in specifically defined whole integer values, (e.g., 1, 2 or 3 parts, etc.), it will be considered a compound properly classified in Class 423. Similarly if atoms or molecules in a chemical formula are not present as whole small integer values or cannot be multiplied by a factor to yield integer values, then the substance represented by the formula will be considered to be a mixture or composition classifiable in a locus other than Class 423. However, see (1) Note in subclass 328 for exception to general rule stated above.
- (14) Note. A water solution (whether preserved or not) of a Class 423 compound or element is classified in Class 423 unless its use is

claimed or a single use is disclosed, in which case classification in the use class is indicated.

- (15) Note. When a patent includes (1) a single claim directed to the formation of 2 or more desired products, or (2) plural, equally comprehensive claims defining processes or products wherein the individual claims would be classified in separate classes, the following rules apply: (1) As between Class 423 and other classes providing for compounds the patent is placed in Class 423. (2) As between Class 423 and Class 75 the patent is placed in Class 75. (3) As between Class 423 and classes providing for compositions, the patent is placed in the composition class.
- (16) Note. Where a process includes a step of recovery of the energy in a fluid (e.g., expansion in a motor to produce mechanical or electrical power, use in a heat exchanger for utilization outside of the process, etc.) the intent of the patentee must be considered for proper classification. If the intent is to conduct the chemical reaction, make the product or purify a gas or separate a mixture as provided for in Class 423 and recovery of the energy in the fluid is simply for economic reasons the classification is proper for Class 423. If the intent of the chemical reaction, is to increase the energy level in the fluid for the purpose of producing the mechanical or electrical power, then classification in another main class is indicated. If the power produced is used in the process, e.g., pumping, refrigeration, heat exchange, etc. classification in Class 423 is proper.
- (17) Note. The rules for determining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the section **LINES WITH OTHER CLASSES AND WITHIN THIS CLASS**, subsection **COMPOSITION CLASS SUPERIORITY**, which includes a hierarchical **ORDER OF SUPERIORITY FOR COMPOSITION CLASSES**.

### **SECTION III - SUBCLASS REFERENCES TO THE CURRENT CLASS**

#### **SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 1+, for treating mixture to obtain metal containing compound (see the Class Definition, above).
- 265+, .for products or processes comprising a compound or a nonmetallic element physically interrelated with another substance which serves to improve, protect or modify the product, which substance does not take part in the reaction, which makes the product, but is added to the reaction or to the product or is made by a separate and distinct reaction.
- 658.5, for extracting, leaching or dissolving processes.

### **SECTION IV - REFERENCES TO OTHER CLASSES**

#### **SEE OR SEARCH CLASS:**

- 23, Chemistry: Physical Processes, for processes of preparing or treating inorganic compounds or nonmetallic elements which involve only physical treatments except for extracting, leaching, or dissolving, per se, and not specifically provided for in some other class; for processes for analysis which involve a chemical reaction.
- 48, Gas: Heating and Illuminating, for processes for making heating and illuminating gas in general and processes and apparatus for purifying a heating and illuminating gas; processes involving a chemical reaction for making or purifying heating or illuminating gas consisting of a single element or organic compound, per se, are classified in Class 423.
- 53, Package Making, appropriate subclasses especially subclasses 428+ for methods of manufacturing chemical compounds followed by a subsequent packaging step.
- 65, Glass Manufacturing, for a process or apparatus for chemically manufacturing silicon or silicon dioxide (arbitrarily considered to be glass for Class 65) combined with significant shaping or heat treating.
- 71, Chemistry: Fertilizers, appropriate subclasses for compositions, and processes of making such compositions, having a nutrient action on plant growth. See (1) Note in the definition of Class 71 and (13) Note and (15) Note in the definition of Class 423 for lines between these two classes.

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, the line with the Class 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, is generally as follows: Class 75 provides for metals and processes for their manufacture. Class 423 provides for chemically modifying metal bearing compositions to form intermediary products which comprise inorganic compounds even if intended for subsequent reduction to free metals. When it is not clear from the claimed disclosure whether the product produced is an intermediary of a free metal, it is assumed to be intermediary. A smelting process is assumed to produce a free metal unless otherwise stated. Class 75 provides for ore beneficiating processes which claim a sintering or agglomerating step, even though the production of a free metal is not claimed, and compounding of ingredient to make a composition which is in better form for pyrometallurgy, even though some chemical reaction is involved. Patents including claims classifiable in Class 423 and equally comprehensive claims classifiable in Class 75 are classified in Class 75 and cross-referenced to Class 423. Processes resulting in the production or separation of undesired metallic material, e.g., impurities, during the manufacture of Class 423 compounds are classified in Class 423. If the metal is a desired material, however, the patent is classified in Class 75. See also the note to Class 420, Alloy or Metallic Composition below. As between Class 75 and Class 423, intermetallic compounds are in Class 75. Processes resulting in the production or separation of undesired metallic material, e.g., impurities, during the manufacture of Class 423 compounds are classified in Class 423. If the metal is a desired material, however, the patent is classified in Class 75.
- 95, Gas Separation: Processes, for processes of a purely physical nature involving steps resulting in separation of a gas from a fluid mixture comprising (a) a gas and solid or liquid particles entrained therein, (b) a liquid and gas entrained therein, or (c) a plurality of gases. For patents to be placed in Class 423, a particular chemical must be claimed and the chemical reaction must be inherent or disclosed. Broadly reciting the separating material as a “chemical” or as “gas purifying material” does not exclude the patent from Class 95. Absorption and adsorption are not considered chemical reactions in this respect. Processes for separating a gaseous fluid mixture having therein ammonia (NH<sub>3</sub>) or acid anhydrides (e.g., CO<sub>2</sub>, SO<sub>2</sub>, etc.) by contacting the gaseous fluid mixture with water and thus dissolving these gases out of the gaseous fluid mixture are in Class 95, notwithstanding the fact that a chemical reaction occurs in the solution and that ammonium hydroxide or the acids are formed. See also, search class note to Class 95 in Class 423, subclass 210.
- 106, Compositions: Coating or Plastic, appropriate subclasses for coating or plastic compositions not otherwise provided for. For the line between Classes 106 and 423. In regard to materials and ingredients, e.g., pigments, see the note to the definition of Class 106 under the heading “Materials or Ingredients”. See also (13) Note and (15) Note in the definition of Class 423 and (4) Note in subclass 265 of that class.
- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including inorganic or organic.
- 134, Cleaning and Liquid Contact With Solids, appropriate subclasses, especially subclasses 2+ for the process of treating a mixture to remove foreign matter from the surface. The line between this Class 134 and Class 423 is as follows: in Class 423 the intent is to recover a metal compound from a mixture thereof, while in Class 134, the intent is merely to clean the mixture, whether or not the removed foreign matter is later treated to recover valuable by-products.
- 148, Metal Treatment, for processes for making case hardened metals and the corresponding products (e.g., carbided or nitrided metals) in which a metal is treated so as to form the nitride or carbide of the metal in more or less as a layer thereon, but which layer varies in composition towards the inside, the intention being to form case hardened metal, not to form a definite compound for recovery thereof.
- 162, Paper Making and Fiber Liberation, appropriate subclasses for process of chemically pre-

- paring or recovering inorganic compound with a fiber liberation step, and especially subclasses 29+ for processes of regenerating, for purposes of reusing, a fiber treating liquor, even though a compound or nonmetallic element for Class 423 is recovered. For the line between this Class 162 and Class 423 in regard to regeneration, the intent of the disclosure must be considered. If there is an intent to regenerate, reconstitute, reclaim or recycle the waste or used liquor being treated, whether or not a Class 423 product is recovered, classification is in Class 162.
- 201, Distillation: Processes, Thermolytic, appropriate subclasses for a process of carbonizing solid carbonaceous material, or for calcining coke to produce a coke or other impure carbon containing material, not otherwise provided for. A document having claims to both the process of coking and the additional steps of producing carbon black will be classified in Class 423 and cross referenced to Class 201.
- 203, Distillation: Processes, Separatory, for a process of separating a liquid mixture by vaporizing and condensing a portion thereof to isolate in the distillate or in the residue a relatively pure compound which was present as such in the original mixture, and for a process including a chemical reaction and a separatory distillation operation when the chemical reaction merely facilitates the isolation by the distillation process of a pre-existing substance in the original mixture. Class 423, Inorganic Chemistry, takes a process of preparing a compound and isolating it by a separatory distillation process or vaporizing a mixture and contacting the vaporous mixture with a substance which purified the mixture and prepares a compound for that class.
- 204, Chemistry: Electrical and Wave Energy, for processes of producing an inorganic compound or nonmetallic element by directly employing electrical or wave energy. The general line between this Class 423, and Class 204 is as follows: Class 423 provides for (1) process steps falling within the definition of Class 204 wherein a simultaneous or subsequent chemical reaction takes place which modified the product of the Class 204 to produce a different compound or element, and (2) branching processes wherein one of the branches comprises a process falling within the definition of Class 204 and at least one branch falls within the definition of Class 423. Class 204 takes processes wherein an initial or preparatory reaction of the type provided for in Class 423 is followed by process step of the type provided for in Class 204 which modifies the product of the initial reaction. In processes where a useful by-product is formed, the patent is classified accordingly.
- (1) Note. If electrolysis takes place in a reagent which immediately reacts with a product of the electrolysis to yield a Class 423 product, classification is proper for Class 423.
- 209, Classifying, Separating, and Assorting Solids, appropriate subclasses, for processes of separating a mixture of compounds by magnetic action. However, processes which include both a chemical reaction and a magnetic separation are classified in the appropriate chemical class, e.g., Class 423, etc.
- 210, Liquid Purification or Separation, for chemical processes where the main intent is to purify a liquid, not to purify or recover a compound or nonmetallic element for Class 423, in regard to treatment of an effluent or waste liquor, the intent of the disclosure must be considered. If it be the main intent to purify the effluent liquor for disposal, classification is in Class 210 even though a product for Class 423 is recovered as an incident to the purification. If the main intent is to treat the effluent to recover a Class 423 product then classification in Class 423 is indicated. If the disclosure contains both intentions and it cannot be determined which is the primary intention, then classification is in Class 423 with cross reference to Class 210 where necessary.
- 252, Compositions, appropriate subclasses, for compositions of matter not otherwise provided for. See the definitions of Class 252 for its scope and the notes thereto for classification of other compositions. See also (13) Note and (15) Note in the definition of Class 423.
- 260, Chemistry of Carbon Compounds, appropriate subclasses, for claimed chemical processes in which an organic compound is the end result, even though the intent is to make an inorganic compound from this organic intermediate. However, a process which results in several different chemical compounds, one of which is classifiable in Class 423 and another is classifiable in Class 260, is classified in Class 423 and cross referenced into Class 260, except where the compound classifiable in Class 423 is only

- incidentally produced by the reaction, such as, for example, HCl and is not an objective of the process.
- 376, Induced Nuclear Reactions: Processes, Systems, and Elements for appropriate subclasses for changes in the chemical nature of materials brought about by nuclear reactions; and subclasses 156+ and 323+ for production of materials, other than or in addition to the conversion of nuclear fuel, by means of nuclear reactions.
- 420, Alloys or Metallic Compositions, appropriate subclasses for alloys, intermetallic compounds or compounds or composition containing a continuous phase of metal and methods of making them. See the class definition of Class 420 for the line between Class 420 and Class 75 for processes for making alloys.
- 422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclasses 1 through 44 for processes for disinfecting, deodorizing, preserving, or sterilizing. Inorganic compounds or nonmetallic elements claimed with an additive which only serves to preserve the product are in Class 423. See also the notes in Class 423, subclasses 265+ and subclasses 45+ for chemical reactors and apparatus for carrying out chemical physical processes.
- 424, Drug, Bio-Affecting and Body Treating Compositions, appropriate subclasses for a Class 423 product combined with an additive which is claimed or solely disclosed as having a Class 424 utility. A Class 423 product having combined therewith an additive which protects the product, itself against biological attack is proper for Class 423, see subclasses 265+.
- 426, Food or Edible Material: Processes, Compositions, and Products, subclasses 160+, for baking powder compositions, which in some cases are made to deliberately contain impurities to stabilize the same and to cause proper reaction rates. In many instances, the compound is calcium acid pyrophosphate and the impurity is a calcium or aluminum compound.
- 428, Stock Material or Miscellaneous Articles, appropriate subclasses, for metallic compounds having specific outer structure, especially subclasses 379+ for a structurally defined or coated rod, strand, fiber or particle which may include a metal compound; subclasses 432 and 469+ for a non structural composite web or sheet including a layer of a metal compound.
- 429, Chemistry: Electrical Current Producing Apparatus, Product, and Process, subclasses 188+ for electrolyte compositions; subclass 247 for materials used to make a battery separator; and other appropriate subclasses having compositions combined with structure.
- 432, Heating, subclasses 1+, for a residual process of heating. The line between Classes 423 and 432 is generally as follows: Class 423 takes heating processes which involve a chemical reaction to produce an inorganic compound or nonmetallic element. Materials identified by, terms such as "lime", "limestone" and "gypsum", are considered to be compounds for Class 423, but terms such as "cement" and "clay" are not. Residual processes which do not include a chemical reaction or do not result in a compound are in Class 432. The terms "calcining", "burning", "removing water of hydration", etc. are considered to involve a chemical reaction.
- 435, Chemistry: Molecular Biology and Microbiology, for processes of making separating or purifying compounds or elements by operations that include fermentation, and compositions and apparatus that are specialized for use therein and processes of making such compositions for such use.
- 504, Plant Protecting and Regulating Compositions, appropriate subclasses for compositions, and processes of making such compositions, having a stimulating or regulating action on plant growth. See (13) Note and (15) Note in the definition of Class 423 for lines between these two classes.
- 505, Superconductor Technology: Apparatus, Material, Process, subclasses 100+ for high temperature ( $T_c$  30 K) superconducting materials, per se, or subclasses 300+ for processes of producing same.
- 585, Chemistry of Hydrocarbon Compounds, appropriate subclasses for a claimed chemical process to synthesize a hydrocarbon. When a process produces an inorganic compound for Class 423 and a hydrocarbon compound for Class 585, both of which are intended to be recovered, the patent is classified as an original in Class 423 and cross-referenced to Class 585.
- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the process of destruction of hazardous or toxic waste by way of incineration heating or other chemical reactions when the destruction of the waste is the intended purpose, Class 423 takes all

intended production or recovery of marketable products in the form of inorganic compounds or elements.

## SECTION V - GLOSSARY

Terms used throughout the schedule and definitions are to have the meanings ascribed below. In some instances all the limitations found below may not have been included in the subclass definitions; all discrepancies should be resolved in favor of the following definitions.

### ABSORPTION

The ability of a substance to retain or concentrate gases, liquids or dissolved substance (absorbate) within its bodies.

### ADSORPTION

The ability of a substance (usually a solid) to retain or concentrate gases, liquids or dissolved substances (adsorbate) upon its surface.

### ALKALI METALS

The metal elements of the first group of the periodic system, consisting of Li, Na, K, Rb, Cs.

### ALKALINE EARTH METALS

The metal elements in Group II A of the periodic system, consisting of Mg, Ca, Sr, Ba.

### BINARY COMPOUND

A chemical compound consisting of 2 elements only with 2 or more atoms; e.g., NaCl, FeCl<sub>3</sub>, Fe<sub>3</sub>O<sub>4</sub>, etc.

### CHALCOGEN

Also known as chalcogenide(s), the elements oxygen, sulfur, selenium, tellurium and polonium.

### CATALYST

A substance which either increases or decreases the speed of a chemical reaction without itself undergoing a permanent change.

### COMPLEX COMPOUND

A chemical combination of two or more compounds or

ions; e.g., 4 KCN and Fe (Cn)<sub>2</sub> give the complex compound K<sub>4</sub>Fe (Cn)<sub>6</sub>; 2 HF and Si F<sub>4</sub> give the complex acid H<sub>2</sub> Si F<sub>6</sub>. An electrically charged radical or group of atoms, e.g., Cu (NH<sub>3</sub>)<sub>2</sub><sup>+</sup>, is a complex ion.

### COMPOUND

The elements or compounds comprising a material or produced from it by analysis.

### COMPOUND

A substance whose molecules consist of unlike atoms, whose constituents cannot be separated by physical means, whose properties are entirely different from those of its constituent elements and which contains definite proportions of its constituent elements, depending on their atomic weights.

### FLOTATION

A process for the concentration of selective separation of components of ores by grinding the ores with a frothing agent, floating them on water and agitating the mixture with compressed air, causing the wet gangue (earthy portion of the ore) to settle and permitting the concentrated ore to be skimmed off.

### FLUIDIZED BED

A mass of solid particles maintained in a state of constant turbulent motion in a gas stream, resulting in a suspension of finely divided particles in a stream of gas thus increasing the surface area and therefor surface activity of the particles.

### HALOGENS

Also known as halogenides, the nonmetallic elements of the seventh group of the periodic system and consisting of F, Cl, Br, I, At.

### INERT GASES

The noble gases of the zero group of the periodic system, consisting of He, Ne, Ar, Kr, Xe, Rn, which have no valency and combine only with great difficulty, if at all, with other elements.

### ION EXCHANGE

A process in which ions are chemically transferred from a material to a liquid or solid separatory substance or

exchanger which, because of its chemical structure of loosely bound ions, has an affinity for certain ions and gives up some of its own ions to the material. The exchange occurs between ions of like charge; the exchanger substance can usually be regenerated by passing another material through it to elute the previously sorbed ions and replace them with the original kind of loosely bound ions. These ion exchange substances are usually resins or zeolites or chelates.

#### IRON GROUP METALS

Those metals in the central part of the third period of the periodic system consisting of Fe, Co and Ni, all of which form colored salts and 2 or more series of compounds.

#### LEACHING

The process of extracting or dissolving a soluble component from a mixture by contacting the mixture with a solvent, resulting in dissolution or solution of the solubles and leaving an insoluble material.

(Note. Solution of a substance in a normally solid, molten material is not considered to be "leaching" as defined above.)

#### LIQUID-LIQUID EXTRACTION

The process of transferring a substance (fluid or solid) from one liquid phase in which it is dispersed or dissolved to a second liquid phase which is immiscible with the first liquid.

#### NONMETALLIC ELEMENTS

The electronegative elements on the right of the periodic system, which generally exist in several stages of oxidation and whose oxides form acids. See main class definition for list of nonmetals for this class.

#### ORGANIC COMPOUND

A compound as defined in the definition of Class 260, Chemistry of Carbon Compounds as qualified by (34) Note.

#### PLATINUM METALS

A group of noble metals that occur together in nature and form 2 groups in the periodic system, i.e., Ru, Rh, Pd, Os, Ir and Pt.

#### PROMOTER

A substance which stimulates or aids the effect of a catalyst.

#### RADIOACTIVE

Able to give off rays by spontaneous disintegration. The radioactive elements are usually those having an atomic number of 84 or greater and the phenomenon of radioactivity is not affected by chemical or physical influences.

#### RARE EARTHS

The oxides of the rare earth metals consisting of the elements having atomic numbers 21, 39, 57-71, inclusive.

#### RECOVERY

The extraction or removal of a valuable constituent from a raw material, by-product or waste product.

#### REFRACTORY METALS

Those metals in Group IV B, V B and VIB of the periodic system, consisting of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo and W, some of which are used in making bricks or cement which resist heat and are slow to soften.

#### TERNARY COMPOUND

A chemical compound consisting of 3 elements only, such as NaOH, H<sub>2</sub>SO<sub>4</sub>, KCN, etc.

#### VOLATIZING

Converting a normally solid or liquid material into a gas or vapor state; mere volatilization of water or a solvent is excluded under this definition.

#### SUBCLASSES

**1** This subclass is indented under the class definition. Processes wherein a mixture is chemically treated to obtain or recover a compound of a metal contained in the original mixture as an element, a compound or a precursor transmutable to the metal.

(1) Note. The chemical reaction need not involve the desired metal, it may be with another constituent of the mixture for



easier separation of the desired compound.

- (2) Note. The following are assumed to be mixtures unless otherwise specifically disclosed or stated: the slightly impure compound, ores, metalliferous materials, minerals, alloys, amalgams, scrap metal, clay, metals coated, plated or jacketed on other metals, or on other material, spent or waste liquors (regenerating, purifying or recovering from) limestone, flue dust, gypsum.
- (3) Note. It must be the inventor's intent that a metal in compound form be obtained, but it is not necessary that this compound be separated from the mixture. For example, the process of changing  $\text{Fe}_2\text{O}_3$  in ore to  $\text{Fe}_3\text{O}_4$  by magnetic roasting in order to obtain a better form for smelting is properly classified in this group of subclasses (151+). Further the initial or starting material must be considered in order to determine whether or not the claimed process is for isolating a metallic compound from a mixture. Where two compounds are first mixed together, as disclosed, and subsequent to a chemical reaction, a separation is made, classification of such a process is not in this group of subclasses even though the initial step of mixing is not claimed; such a patent may be classified in other areas of this class on other features. Also, where a mixture results from an intermediate step in a process for making a product and the mixture is separated, that is not considered as treating a mixture to obtain metal compounds for this group of subclasses.
- (4) Note. Changing the form of a compound to render it less effective as an impurity or to make it nondetrimental is not considered to be recovery under this definition. Further, converting part of a mixture which is considered an impurity to the desired part is not considered to be recovery under this definition. For example converting the  $\text{Na}_2\text{CO}_3$  in a mixture with  $\text{Na}_2\text{S}$  to  $\text{Na}_2\text{S}$ , therefore resulting in all  $\text{Na}_2\text{S}$ , is not recovery.

#### SEE OR SEARCH CLASS:

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, appropriate subclasses, for a process of (1) purifying mixtures and obtaining the free metal, (2) making agglomerates for metallurgical purposes, (3) smelting (which is assumed to result in the free metal unless otherwise specifically disclosed), (4) cementation of one metal on another, (5) deposition of a metal on another material (6) making an impure metal but in the elemental form. As between Classes 423 and 75, the claimed process which goes to the metallic compound indicates classification in Class 423, whether the purpose is to commercially use the compound or to later dissociate the compound to obtain the free metal, while the additional claimed step of yielding the free metal brings the claim to Class 75; in the situation where some of the claims recite the metal and others recite the metallic compound, the most comprehensive or combination claim controls (free metal) and the document is classified in Class 75; similarly if the intent is to obtain both the metal and the compound and both processes are claimed the patent goes to Class 75, as an original. If a metal which is definitely only an impurity is removed as an element and the desired metal is in compound form, classification of the original is in Class 423.
- 134, Cleaning and Liquid Contact With Solids, subclasses 2+, for a process of removing foreign matter from a metallic substance, where the intent is merely for cleaning purposes, not to recover a metal containing compound.
- 209, Classifying, Separating, and Assorting Solids, appropriate subclasses, for separating parts of a solid mixture where no chemical reaction is involved.
- 216, Etching a Substrate: Processes, for etching of any material not otherwise

- provided for, and including composite substrates or mixtures.
- 241, Solid Material Comminution or Disintegration, for ore crushing and physical separation.
- 299, Mining or In Situ Disintegration of Hard Material, for in situ chemical separation.
- 420, Alloy or Metallic Compositions, appropriate subclasses for alloys, intermetallic compounds or composition containing a continuous phase of metal and methods of making them.
- 432, Heating, subclasses 1+, for a residual process of applying heat to a material.
- 2** This subclass is indented under subclass 1. Processes in which the compound comprises a metal which exhibits spontaneous nuclear disintegration with emission of radioactive particles, either as (1) the naturally unstable metal which has an atomic number of at least 84, or (2) a metal which has been treated to render an isotope thereof radioactive; see Glossary.
- (1) Note. Compounds of the trans-actinide elements, i.e., those having atomic numbers greater than 103 will be found in this group of subclasses.
- (2) Note. Patents wherein the claims are directed to making an element radioactive or to forming a different isotope of a radioactive element are classified in Class 376, Induced Nuclear Reactions: Processes, Systems, and Elements, subclasses 156+ even when the element is in compound form.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
249+, for a radioactive compound, element or isotope, per se.
- 3** This subclass is indented under subclass 2. Processes in which the radio-active compound comprises a metal of the actinide series, i.e., one having an atomic number of 89 or greater.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, for processes in general of obtaining pure metal values in a metallurgical process and particularly subclass 84.1 for pyrometallurgical processes for obtaining actinide and trans-actinide series metals. Production of the metal, e.g., uranium, plutonium, etc., compounds or concentrates as products even if disclosed for metallurgical purposes are classified in this and indented subclasses.
- 204, Chemistry: Electrical and Wave Energy, appropriate subclasses for electrical or wave energy preparation, separation, or recovery of actinide series products. Also see the References to Other Classes section of the Class 204 definition for the general class line between Class 204 and Class 423.
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclasses 43+ for electrolytic processes involving an actinide series element or compound, including preparation, separation, or recovery of actinide series products.
- 376, Induced Nuclear Reactions: Processes, Systems, and Elements, for processes of producing a reaction product by an impact or bombardment of a nucleus and in subclass 189, 195, 198, and 201 for such processes followed by product treatment for recovery or separation.
- 420, Alloys or Metallic Compositions, subclasses 1+ for alloys, metallic compositions or intermetallic compounds containing an actinide or transactinide series metal.
- 4** This subclass is indented under subclass 3. Processes in which the actinide metal comprises a nuclear fuel element and is obtained by treating the fuel element to remove the covering or casing material therefrom.
- SEE OR SEARCH CLASS:  
252, Compositions, subclasses 625+, for processes producing a useful compo-

- sition containing actinide series elements and such compositions.
- 376, Induced Nuclear Reactions: Processes, Systems, and Elements, subclasses 409+ for the structure of the fuel element, per se.
- 534, Organic Compounds, for organic actinide compounds and methods of making the same, in particular subclasses 11+ for carbocyclic or acyclic actinide compounds. See also main class definition of Class 260.
- 5** This subclass is indented under subclass 3. Processes in which the treatment includes the step of melting material or using molten material.
- 6** This subclass is indented under subclass 2. Processes which include (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) using a substance which has an affinity for and retains a selected component or portion of the mixture being treated; see Glossary.
- SEE OR SEARCH CLASS:
- 95, Gas Separation: Processes, subclasses 90+ for processes of gas separation using solid sorbents, per se.
- 210, Liquid Purification or Separation, subclasses 24+, for processes of separation in general by ion exchange or sorption.
- 7** This subclass is indented under subclass 6. Processes in which the substance is an organic synthetic resin.
- (1) Note. For the definition of "synthetic resin", see Class 520, subclass 1.
- 8** This subclass is indented under subclass 3. Processes which include the step of selectively dissolving a compound in one of two contacting immiscible liquids for separation; see Glossary.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 24, 54, 63, 70, 112, 139, 157, and 181, for processes of treating mixtures including a desired metal to form a compound of the metal, in which the step of liquid-liquid extraction is utilized.
- 9** This subclass is indented under subclass 8. Processes in which one of the immiscible liquids is an organic solvent containing nitrogen, e.g., amines, etc.
- SEE OR SEARCH CLASS:
- 260, Chemistry of Organic Compounds, appropriate subclasses for nitrogen containing organic solvents.
- 10** This subclass is indented under subclass 8. Processes in which one of the liquids is an organic solvent which contains phosphorus.
- SEE OR SEARCH CLASS:
- 260, Chemistry of Organic Compounds, appropriate subclasses for phosphorus containing organic solvents.
- 11** This subclass is indented under subclass 3. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 12** This subclass is indented under subclass 11. Processes in which another substance is caused to become insoluble and acts to carry out ions of the actinide series metal while coming out of solution.
- (1) Note. In some instances, the carrier compound acts to sorb the additional ions.
- 13** This subclass is indented under subclass 12. Processes in which the other compound comprises bismuth.
- 14** This subclass is indented under subclass 12. Processes in which the other compound comprises lanthanum.

- 15** This subclass is indented under subclass 11. Processes in which a compound formed contains the ammonium ( $\text{NH}_4^+$ ) radical or another metal in addition to an actinide series metal.
- (1) Note. In this subclass will be found, for example, double salts of uranium compounds, i.e., those containing at least two cations and which crystallize as a single substance but ionize as two substances, and compounds of uranic acid ( $\text{U}_2\text{O}_7^{2-}$ ).
- 16** This subclass is indented under subclass 11. Processes which include forming a peroxide such as  $\text{UO}_4$ , etc.
- 17** This subclass is indented under subclass 11. Processes which include making a separation by using a carbonate as an active ingredient to leach, wash, or dissolve; see Glossary.
- 18** This subclass is indented under subclass 11. Processes which include making a separation by using an acid as an active ingredient to leach, wash, or dissolve; see Glossary.
- 19** This subclass is indented under subclass 3. Processes including the step of causing a normally liquid or solid substance in element or compound form to be changed into a gas or a vapor; see Glossary.
- (1) Note. Mere volatilization of water or a solvent to concentrate a solution is not included under this definition; classification of such a process is based on other features.
- 20** This subclass is indented under subclass 3. Processes which include making a separation by using an acid as an active ingredient to leach, wash, or dissolve; see Glossary.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
18, for similar processes which include acid leaching in combination with forming an insoluble substance in a liquid.
- 21.1** **Rare earth metal (At. No. 21, 39, or 57-71):**  
This subclass is indented under subclass 1. Processes in which the compound comprises one of the metals known as the “rare earth metals” and which has an atomic number of 21, 39, or 57-71, inclusive.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the treatment of hazardous or toxic waste containing rare earth metals (atomic numbers 21, 39, or 57-71).
- 21.5** **Ion exchanging or liquid-liquid extracting:**  
This subclass is indented under subclass 21.1. Processes which include the step of (a) attracting and retaining a compound of the mixture by contact with an ion exchange substance or (b) selectively dissolving a compound in one of two immiscible liquids to effect a separation; see Glossary.
- 22** This subclass is indented under subclass 1. Processes in which the compound comprises one of the metals known as the platinum group metals, i.e., ruthenium, rhodium, palladium, osmium, iridium or platinum.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing platinum group elements (ruthenium, rhodium, palladium, osmium, iridium, or platinum).
- 23** This subclass is indented under subclass 1. Processes wherein the compound comprises copper, silver or gold.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 100, 117 and 118, for hydrometallurgical processes wherein the metal values recovered consist of copper, silver or gold in elemental form.

- 556, Organic Compounds, subclasses 110+ for organo-metallo compounds containing copper, silver or gold or the processes for preparing such compounds.
- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste being volatilized or containing (Cu, Ag, or Au) halogens, oxygen sulfur, or nitrogen.
- 24** This subclass is indented under subclass 23. Processes , which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.
- 25** This subclass is indented under subclass 23. Processes which include the step of attracting or retaining a component or portion of the mixture by means of magnetic lines of force or by selective adherence to the surface of a solid; see Glossary.
- 26** This subclass is indented under subclass 23. Processes which include the step of floating or causing concentrated metal values of the mixture to rise to the top and to be skimmed off while the earthy portions of the ore are permitted to settle; see Glossary.
- 27** This subclass is indented under subclass 23. Processes , including a step of causing separation by leaching, washing or dissolving out; see Glossary.
- SEE OR SEARCH CLASS:
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 101+, for a process of obtaining a pure elemental metal and including the step of leaching with a chemical.
- 28** This subclass is indented under subclass 27. Processes which specify a particular particle size or range for the starting mixture, the intermediate or the final product.
- 29** This subclass is indented under subclass 27. Processes in which one of the active leaching ingredients is a cyanide.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 371+, for a cyanide compound, per se, or the process of preparing such a compound where the starting material is substantially a pure substance.
- SEE OR SEARCH CLASS:
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 105 for the process of obtaining a pure elemental metal and which includes the step of leaching with a cyanide compound.
- 30** This subclass is indented under subclass 29. Processes in which a pressure above atmospheric is employed while the leaching is being effected.
- (1) Note. Included under this definition is the use of gas under pressure contacting the mixture either above the surface thereof or as a submerged blast.
- 31** This subclass is indented under subclass 29. Processes , wherein the reaction mixture is subjected to stirring, vibration or mixing while being leached.
- (1) Note. The agitation of the mixture may be effected by any means, e.g., fluid, mechanical or sonic, etc.
- 32** This subclass is indented under subclass 27. Processes in which one of the active leaching ingredients is ammonia or an ammonium compound.
- SEE OR SEARCH CLASS:
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 103, for a process of obtaining a pure elemental metal and which includes the step of leach-

ing with ammonia or an ammonium compound.

- 33** This subclass is indented under subclass 32. Processes wherein a specified temperature or range thereof is recited.

(1) Note. This subclass includes patents which specify a temperature preceding, during or following the leaching step.

- 34** This subclass is indented under subclass 27. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein, and comes out of solution or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.

(1) Note. Included under this definition of insolubilization is that wherein a substance crystallizes out of solution due to temperature or concentration change.

(2) Note. The compounds formed by the titles specifically set out in the indented subclasses need not be those which come out of the solution; they may remain soluble while others formed by the process precipitate out.

SEE OR SEARCH THIS CLASS, SUBCLASS:

42+, for a process of forming an insoluble substance in a liquid which process does not involve a leaching step.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 101+ for a process of obtaining a pure elemental metal, which includes the step of chemical leaching and which may involve precipitating a substance or causing it to come out of solution; and subclasses 106+ for a process of obtaining a pure elemental element by causing it or a compound thereof to come out of solution and which

involves leaching with a cyanide compound.

- 35** This subclass is indented under subclass 34. Processes in which an oxide or carbonate is formed.

- 36** This subclass is indented under subclass 34. Processes which includes chemically forming a compound having the sulfate ( $\text{SO}_4^{2-}$ ) radical.

(1) Note. In this subclass may be found disclosures to double sulfates of a monovalent metal and a tri-valent metal.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 110 and 115+ for a process of obtaining a pure elemental metal and which involves the formation of a sulfate compound.

- 37** This subclass is indented under subclass 34. Processes which includes chemically forming a compound having the sulfide ( $\text{S}^{2-}$ ) ion.

- 38** This subclass is indented under subclass 27. Processes which include chemically forming a halogen containing compound.

(1) Note. Included in this and the indented subclasses are methods of wet or dry chloridizing precedent to or subsequent to leaching.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 111+ for a process of forming a pure elemental metal which includes the step of chloridizing.

- 39** This subclass is indented under subclass 38. Processes in which a specific temperature or a range of temperatures is recited during at least part of the process either for the mixture or for a substance involved in the process.

- 40 This subclass is indented under subclass 38. Processes in which the halogen in the compound formed is chlorine and is provided by using as a reactant either chlorine gas or chlorinated water.
- 41 This subclass is indented under subclass 27. Processes which include chemically forming a compound having the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
36, for a process of forming a similar metal compound which includes the step of forming a sulfate as well as the steps of leaching or dissolution and causing a substance to become insoluble in, or precipitate out of a liquid or slurry.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 110 and 115+ for a process of obtaining a pure elemental metal which includes the step of sulfating.
- 42 This subclass is indented under subclass 23. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and other materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 108+ for a process of obtaining a pure elemental
- metal and which includes step of precipitation.
- 43 This subclass is indented under subclass 42. Processes in which specific alkalinity or acidity is employed during the process.
- 44 This subclass is indented under subclass 23. Processes including the step of causing copper, silver or gold in either the elemental or compound form to pass into the form of a gas or a vapor; see Glossary.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 111+ for a process of obtaining a pure elemental metal which may include a step of volatilizing a substance.
- 45 This subclass is indented under subclass 23. Processes which include chemically forming a compound containing the ( $\text{SO}_4^{2-}$ ) sulfate radical.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
36, for a process in which a similar sulfate compound is formed, but in which also a substance is caused to come out of solution in a liquid or slurry and in which leaching is effected.  
41, in which a similar sulfate compound is formed and in which leaching effected.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 110 and 115+ for a process of obtaining a pure elemental metal and which involves the formation of a sulfate compound.
- 46 This subclass is indented under subclass 23. Processes which include chemically forming a halogen containing compound.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

38+, for a process of obtaining a similar metal compound in which a halogen containing compound is formed and in which the step of leaching or dissolution is included.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass 110 and 111+ for a process of obtaining a pure elemental metal and which involves the formation of a chlorine containing compound.

47 This subclass is indented under subclass 23. Processes including the removal of sulfur or of arsenic from the mixture.

SEE OR SEARCH CLASS:

75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclass for a process of removing at least a portion of the sulfur or of the arsenic from an ore for the purpose of concentrating the metal values of the ores.

48 This subclass is indented under subclass 23. Processes which include forming a sulfide compound or a mixture of sulfides known as a matte.

49 This subclass is indented under subclass 1. Processes wherein the compound comprises manganese, technetium or rhenium.

(1) Note. Technetium does not occur naturally; it is a fission product of uranium. Compounds of technetium are known, however, e.g.,  $Tc_2^{+7}$ ,  $NH_4Tc^{+4}$ , etc.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

2+, for processes of treating mixtures to obtain radioactive group VIIB metal compounds and subclasses 249+ for

the radioactive metal compound, per se.

SEE OR SEARCH CLASS:

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing (Mn, Tc, or Re) halogen, oxygen, or sulfur.

50 This subclass is indented under subclass 49. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.

(1) Note. Crystallization of a substance is included under this definition of insolubilization.

51 This subclass is indented under subclass 50. Processes including the step of chemically forming a compound containing a halogen.

52 This subclass is indented under subclass 50. Process including the step of forming a compound containing the sulfate ( $SO_4^{2-}$ ) radical.

53 This subclass is indented under subclass 1. Processes wherein the compound comprises chromium, molybdenum, or wolfram (tungsten).

SEE OR SEARCH CLASS:

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste being volatilized or containing Cr, Mo, or W.

54 This subclass is indented under subclass 53. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.



- 55** This subclass is indented under subclass 53. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 56** This subclass is indented under subclass 55. Processes including the step of chemically forming a compound which contains the ammonium ( $\text{NH}_4^+$ ) or nitrate ( $\text{NO}_3^-$ ) radical.
- 57** This subclass is indented under subclass 55. Processes including the step of chemically forming a compound having the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- 58** This subclass is indented under subclass 55. Processes including the step of chemically forming a compound which contains at least two metals.
- 59** This subclass is indented under subclass 53. Processes including the step of causing a normally solid or liquid substance in either elemental or compound form to be changed into a gas or a vapor; see Glossary.
- 60** This subclass is indented under subclass 59. Processes wherein the substance is a compound which contains chlorine.
- 61** This subclass is indented under subclass 53. Processes including the step of chemically forming a compound which contains at least two metals.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
58, for process of forming a plural metal containing compound containing a Group VIB metal from a mixture, which process also includes forming an insoluble substance in a liquid.
- 62** This subclass is indented under subclass 1. Processes wherein the compound comprises vanadium, niobium, or tantalum.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing V, Nb, or Ta.
- 63** This subclass is indented under subclass 62. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance, or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.
- 64** This subclass is indented under subclass 62. Processes wherein the compound is separated from liquids which are organic compounds, i.e., those nonpolar compounds consisting of carbon and hydrogen with or without other elements (except for those compounds in which carbon plays an unimportant part, as carbonates) e.g., petroleum oils, etc.
- 65** This subclass is indented under subclass 62. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 66** This subclass is indented under subclass 65. Processes including the step of chemically forming a hydroxide or a hydrate.
- 67** This subclass is indented under subclass 65. Processes including the step of chemically forming a compound which contains the ammonium ( $\text{NH}_4^+$ ) radical or the sulfate ( $\text{SO}_4^{2-}$ ) radical.

- 68** This subclass is indented under subclass 62. Processes which include leaching, washing, or dissolving out a portion of the mixture; see Glossary.
- 69** This subclass is indented under subclass 1. Processes wherein the compound comprises titanium, zirconium, or hafnium.
- SEE OR SEARCH CLASS:
- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, especially subclasses 84+ for a process in which Ti, Zr, or Hf is reduced to metallic state from a compound thereof after a treatment to separate such compounds from mixtures.
- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the treatment of hazardous or toxic containing Ti, Zr, or Hf.
- 70** This subclass is indented under subclass 69. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance, or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.
- 71** This subclass is indented under subclass 69. Processes including chemically forming a compound which contains at least two metals.
- 72** This subclass is indented under subclass 71. Processes in which the compound also contains a halogen.
- 73** This subclass is indented under subclass 69. Processes in which the mixture contains at least two members from the group comprising Ti, Zr, and Hf, and in which one of these members is recovered separately from any other.
- 74** This subclass is indented under subclass 69. Processes in which solids are suspended in upward flowing gas or vapor, the upward force of the fluid on the solids being countered by gravity, resulting in the formation of a zone in which the particles are compacted into a dense phase; see Glossary.
- (1) Note. The particles are in a state of hindered settling and the dense bed resembles a boiling liquid and above this dense bed some solids may be suspended in a dilute or dispersed phase.
- 75** This subclass is indented under subclass 69. Processes which include the step of causing a normally solid or liquid substance in either elemental or compound form to be changed into a gas or vapor; see Glossary.
- SEE OR SEARCH CLASS:
- 203, Distillation: Processes, Separatory, appropriate subclasses, especially subclasses 28+ for a process which includes a chemical reaction solely for the purpose of facilitating the isolation by distillation of a component of the original mixture. A process which includes vaporizing an impure mixture and then chemically treating the impure vapor to recover or separate therefrom a desired metal compound is classified in Class 423; see also reference to Class 203 in section III, Line and Search Notes.
- 76** This subclass is indented under subclass 75. Processes in which titanium, zirconium or hafnium is volatilized in elemental or compound form.
- (1) Note. This subclass includes processes where an impure chloride is purified by distillation of the Group IVB metal chloride.
- 77** This subclass is indented under subclass 76. Processes in which the vapor stream is treated to remove undesired materials, the Group IVB metal values remaining in vapor form during the separation.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 75, and 76, for a process in which either the undesirable material or the Ti, Zr, or Hf is volatilized, there being no separation of one from the other in the vapor stream.

- 78** This subclass is indented under subclass 76. Processes in which volatilization takes place using solids which have been given a claimed physical shape; e.g., briquettes, pellets, etc.
- SEE OR SEARCH CLASS:  
264, Plastic and Nonmetallic Article Shaping or Treating: Processes, appropriate subclasses, for briquetting or otherwise shaping solid mixtures.
- 79** This subclass is indented under subclass 76. Processes in which the vaporization of the Ti, Zr, or Hf is effected during contact of a solid feed material with gaseous chlorine.
- 80** This subclass is indented under subclass 69. Processes in which a chemical reaction is performed upon the mixture to enable two solid components of the mixture, usually of different compositions, to be more readily separated from each other by nonchemical methods and while the components are still in a solid-state.
- (1) Note. Examples of solid-solid separation are: magnetic, gravity, centrifugal, etc. Solution (leaching) of one of the solids is not considered to be solid-solid separation for this subclass.
- SEE OR SEARCH CLASS:  
209, Classifying, Separating, and Assorting Solids, for methods and apparatus for solid-solid separation, per se, especially subclasses 3+ for treatments, preliminary to a solid-solid separation, which do not involve a chemical reaction.
- 81** This subclass is indented under subclass 69. Processes which include the step of reacting or contacting the mixture with a compound which contains nitrogen, e.g., nitric acid, ammonia, etc.
- 82** This subclass is indented under subclass 69. Processes which include the step of reacting or contacting the mixture with an acid which contains sulfur or a halogen, e.g., H<sub>2</sub>S, H<sub>2</sub>SO<sub>4</sub>, HCl, etc.
- 83** This subclass is indented under subclass 82. Processes which include the formation of iron in elemental form or of an insoluble iron containing compound.
- 84** This subclass is indented under subclass 69. Processes which include the step of reacting or contacting the mixture with a compound which contains an alkali metal or an alkaline earth metal.
- 85** This subclass is indented under subclass 69. Processes in which a liquid or slurry is treated to form a substance containing a Group IVB metal and which substance is insoluble in, and comes out of solution from, the liquid or slurry, or the composition of the liquid is changed so that the part of the mixture containing the Group IVB metal becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid or slurry.
- 86** This subclass is indented under subclass 69. Processes which include the step of dissolving or leaching iron and thereby separating it from part of the original mixture; see Glossary.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
150.3, for general processes for chemically leaching iron values from iron-bearing ores.
- 87** This subclass is indented under subclass 1. Processes in which the compound comprises antimony, bismuth or arsenic.
- (1) Note. For purposes of this Class 423, arsenic is considered to be a metal.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing Sb, Bi, or As.
- 88** This subclass is indented under subclass 87. Processes which include the step of causing a normally solid or liquid substance in either elemental or compound form to be changed into a gas or a vapor; see Glossary.

- 89** This subclass is indented under subclass 1. Processes in which the compound comprises germanium, tin, or lead.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing Ge, Sn, or Pb.
- 90** This subclass is indented under subclass 89. Processes in which the compound comprises tin and is obtained by treating an article or waste material of a mixture of metals which includes tin (e.g.,terne plate, tin plate, cans, etc.).
- SEE OR SEARCH CLASS:  
134, Cleaning and Liquid Contact With Solids, subclasses 2+ for a process of treating articles or material for the purpose of cleaning or removing foreign matter therefrom, not to remove or strip a metal coating to recover the metal.
- 91** This subclass is indented under subclass 90. Processes in which the article or waste material is treated with a halogen which is either in the free state or combined with hydrogen as a halogen containing acid.
- 92** This subclass is indented under subclass 89. Processes in which a liquid or slurry is treated to form a substance which is insoluble in and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 93** This subclass is indented under subclass 92. Processes in which a chemical reaction takes place while the pressure on the mixture is higher than atmospheric or while the mixture is agitated or vibrated.
- (1) Note. Agitation or vibration can be effected by any means, e.g., mechanical, sonic, fluid, etc. Pressure increase can be effected by any means, e.g., submerged blast of a gas into a liquid or slurry mixture, pumping of the liquid or slurry mixture, increase in pressure of the gas space above a liquid surface, etc.
- 94** This subclass is indented under subclass 92. Processes which includes the step of chemically forming a compound containing a halogen.
- 95** This subclass is indented under subclass 92. Processes which include the step of chemically forming a compound which contains the nitrate (NO<sub>3</sub>.) radical or the sulfate (SO<sub>4</sub><sup>2-</sup>) radical.
- 96** This subclass is indented under subclass 89. Processes including the step of causing germanium or tin in elemental or compound form to be changed into a gas or vapor; see Glossary.
- 97** This subclass is indented under subclass 89. Processes including the step of causing lead in elemental or compound form to be changed into a gas or vapor; see Glossary.
- 98** This subclass is indented under subclass 89. Processes which include leaching, washing or dissolving out a portion of the mixture; see Glossary.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
90, for a process of destining scrap metal by forming and dissolving a tin compound.
- 99** This subclass is indented under subclass 1. Processes wherein the compound comprises zinc, cadmium or mercury.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing Zn, Cd, or Hg.

- 100** This subclass is indented under subclass 99. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) attracting and separating a component of the mixture from another component by means of magnetic lines of force; see Glossary.
- 101** This subclass is indented under subclass 99. Processes wherein a liquid or a slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 102** This subclass is indented under subclass 101. Processes in which a chemical reaction takes place while the mixture is agitated or vibrated.
- (1) Note. Agitation or vibration can be effected by any means, e.g., mechanical, sonic, fluid, etc.
- 103** This subclass is indented under subclass 101. Processes including the step of chemically forming a compound which contains a halogen.
- 104** This subclass is indented under subclass 101. Processes including the step of chemically forming a hydroxide or a hydrate.
- 105** This subclass is indented under subclass 101. Processes including the step of chemically forming a compound having the carbonate ( $\text{CO}_3^{2-}$ ) radical.
- 106** This subclass is indented under subclass 101. Processes including the step of chemically forming a compound having the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- 107** This subclass is indented under subclass 99. Processes including the step of causing zinc, cadmium or mercury in elemental or compound form to be changed into a gas or a vapor; see Glossary.
- 108** This subclass is indented under subclass 107. Processes wherein the mixture contains lead.
- 109** This subclass is indented under subclass 99. Processes which include leaching, washing, or dissolving out a portion of the mixture; see Glossary.
- 110** This subclass is indented under subclass 99. Processes including the step of removing at least some sulfur from the mixture.
- 111** This subclass is indented under subclass 1. Processes wherein the compound comprises beryllium, aluminum, gallium, indium or thallium.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing, Al, Ga, In, Tl, or Be.
- 112** This subclass is indented under subclass 111. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.
- 113** This subclass is indented under subclass 111. Processes wherein a separation is made by attracting and separating a component of the mixture from another component by means of magnetic lines of force; see Glossary.
- 114** This subclass is indented under subclass 111. Processes including the step of chemically forming a compound which contains the ammonium radical and a metal.
- 115** This subclass is indented under subclass 111. Processes including the step of chemically forming a compound which contains a plurality of metals.

- 116** This subclass is indented under subclass 115. Processes wherein the compound also contains a halogen.
- 117** This subclass is indented under subclass 115. Processes wherein the compound also contains sulfur.
- 118.1 Aluminosilicate other than zeolite:**  
This subclass is indented under subclass 115. Processes wherein the compound is an aluminosilicate, other than a zeolite, containing silicon, oxygen, aluminum, and another metal; e.g., sodium aluminosilicate.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
700+, for products and processes for producing zeolites.
- 119** This subclass is indented under subclass 115. Processes wherein the compound is an alkali metal aluminate, e.g., sodium aluminate ( $\text{Na}_2\text{Al}_2\text{O}_4$  or  $\text{Na Al O}_2$ ).
- 120** This subclass is indented under subclass 119. Processes wherein the mixture or source material includes the mineral alunite, which is naturally occurring  $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 4\text{Al}(\text{OH})_3$  or  $\text{KAl}_3(\text{OH})_6(\text{SO}_4)_3$ .
- 121** This subclass is indented under subclass 119. Processes wherein the mixture or source material is the mineral bauxite, which is naturally occurring  $\text{Al}_2\text{O}(\text{OH})_4$ .
- 122** This subclass is indented under subclass 111. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 123** This subclass is indented under subclass 122. Processes wherein a chemical reaction takes place while the pressure on the mixture is either higher or lower than atmospheric; or while steam or water vapor is brought into contact with the mixture.
- (1) Note. Pressure increase, or decrease can be effected by any means, e.g., submerged blast of a gas into a slurry or liquid, pumping of the liquid or slurry, increase or decrease in pressure of the gas space above a liquid surface, etc.
- 124** This subclass is indented under subclass 122. Processes wherein a chemical reaction takes place while the mixture is agitated or vibrated.
- (1) Note. Agitation or vibration can be effected by any means, e.g., mechanical, sonic, fluid, etc.
- 125** This subclass is indented under subclass 122. Processes including the step of chemically forming a compound having the nitrate ( $\text{NO}_3^-$ ) radical.
- 126** This subclass is indented under subclass 122. Processes which include the step of chemically forming a compound having a halogen as part thereof.
- 127** This subclass is indented under subclass 122. Processes including the step of chemically forming a hydroxide or a hydrate.
- 128** This subclass is indented under subclass 122. Processes including the step of chemically forming a compound containing the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- 129** This subclass is indented under subclass 122. Processes including the step of chemically forming a compound having the carbonate ( $\text{CO}_3^{2-}$ ) radical.
- 130** This subclass is indented under subclass 111. Processes in which the mixture contains an impurity which meets the definitions of an organic compound and the process includes a step of (1) removing the impurity from the

mixture or (2) doing away with or breaking up completely the impurity.

- (1) Note. The organic impurity may be done away with or broken up completely by any means, as for example, chemical or flame oxidation, or combustion, etc.

**131** This subclass is indented under subclass 111. Processes which include leaching, washing, or dissolving out a portion of the mixture; see Glossary.

**132** This subclass is indented under subclass 131. Processes in which an acid is used as the leaching, washing or the solvent medium.

**133** This subclass is indented under subclass 111. Processes including the step of causing a normally solid or liquid substance in either element or compound form to be changed into a gas or a vapor; see Glossary.

**134** This subclass is indented under subclass 133. Processes in which the substance is beryllium.

**135** This subclass is indented under subclass 133. Processes in which the substance is aluminum, gallium, indium or thallium.

**136** This subclass is indented under subclass 135. Processes which include the step of reacting an uncombined halogen.

**137** This subclass is indented under subclass 111. Processes in which include the step of using elemental carbon as a reducing agent.

**138** This subclass is indented under subclass 1. Processes wherein the compound comprises one of the three metals in Period 4, Group VIII of the periodic system, i.e., iron, cobalt or nickel, commonly known as the iron group metals; see Glossary.

**SEE OR SEARCH CLASS:**

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing Fe, Co, and Ni.

**139** This subclass is indented under subclass 138. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance, or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.

**140** This subclass is indented under subclass 138. Processes wherein a liquid or a slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.

- (1) Note. Crystallization of a substance is included under this definition of insolubilization.

**141** This subclass is indented under subclass 140. Processes wherein a chemical reaction takes place while the pressure on the mixture is either higher or lower than atmospheric; or while steam or water vapor is brought into contact with mixture.

- (1) Note. Pressure increase or decrease can be effected by any means, e.g., submerged blast of a gas into a slurry or liquid, pumping of the liquid or slurry, increase or decrease in pressure of the gas space above a liquid surface, etc.

**142** This subclass is indented under subclass 140. Processes wherein the mixture is agitated or vibrated while a chemical reaction is taking place.

- (1) Note. Agitation or vibration can be effected by any means, e.g., mechanical, sonic, fluid, etc.

**143** This subclass is indented under subclass 140. Processes wherein a nitrogen containing compound is formed, reacted, or placed in contact with the mixture during part of the process.

**144** This subclass is indented under subclass 143. Processes including the step of chemically forming a hydroxide, or a hydrate, or a compound having the carbonate ( $\text{CO}_3^{2-}$ ) radical.

**145** This subclass is indented under subclass 143. Processes including the step of chemically forming a compound containing the sulfate ( $\text{SO}_4^{2-}$ ) radical.

**146** This subclass is indented under subclass 140. Processes including the step of forming a compound containing the sulfate ( $\text{SO}_4^{2-}$ ) radical.

**147** This subclass is indented under subclass 146. Processes including the step of chemically forming a hydroxide, or a hydrate or a compound containing a halogen element.

**148** This subclass is indented under subclass 138. Processes in which solids are suspended in upward flowing gas or vapor, the upward force of the fluid on the solids is countered by gravity resulting in the formation of a zone in which the particles are compacted into a dense phase; see Glossary.

- (1) Note. The particles are in a state of hindered settling and the dense bed resembles a boiling liquid and above this dense bed some solids may be suspended in a dilute or dispersed phase.

**149** This subclass is indented under subclass 138. Processes including the step of causing any of the iron group metals either as an element or a compound to be changed into a gas or a vapor; see Glossary.

**150.1 Leaching, washing, or dissolving:**  
This subclass is indented under subclass 138. Processes which include removing or bringing into solution matter by leaching, washing, or dissolving out a portion of the mixture - see glossary.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 140+, for leaching processes which further include a step of forming an insoluble substance in a liquid.

**150.2 Spent catalyst:**  
This subclass is indented under subclass 150.1. Processes that include recovering values from catalysts.

SEE OR SEARCH CLASS:

- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 22+ for processes of treating in a liquid phase to regenerate or rehabilitate a catalyst.

**150.3 Treatment of iron containing waste mixture:**  
This subclass is indented under subclass 150.1. Processes which include treatment of iron containing product stream that is a by-product or discarded product of another process (e.g., products of pickle liquor).

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 531, for removal or separation of impurities present in sulfuric acid or reactants that form sulfuric acid.

SEE OR SEARCH CLASS:

- 208, Mineral Oils: Processes and Products, subclass 13 for treatment of mineral oil refining sludge.  
216, Etching a Substrate: Processes, particularly subclass 93 for methods of chemical etching including a step of recycling the etchant.

**150.4 Treatment of matte or nodule:**  
This subclass is indented under subclass 150.1. Processes in which the mixture is a matte or nodule containing material (i.e., in form of roasted or smelted ore) or relatively small lumps of mineral.

**150.5 Gas injected into mixture:**  
This subclass is indented under subclass 150.4. Processes which include a step of injecting matter that is gaseous at ambient temperature into the mixture.

**150.6 With electrolytic or magnetic separation:**  
This subclass is indented under subclass 150.1. Process which include a step of removing a component from the mixture by electric current or magnetomotive force.



- SEE OR SEARCH CLASS:
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, appropriate subclasses for electrolytic processes.
- 209, Classifying, Separating, and Assorting Solids, appropriate subclasses for processes of separating a mixture by magnetic action without a chemical reaction.
- 210, Liquid Purification or Separation, subclasses 222+ for processes of separation in liquids by magnetic attraction.
- 151** This subclass is indented under subclass 138. Processes including the step of changing a metal from a nonmagnetic to a magnetic form.
- (1) Note. Although many patents in this subclass are drawn to “magnetic roasting”, i.e., roasting of  $\text{Fe}_2\text{O}_3$  to form magnetic  $\text{Fe}_3\text{O}_4$  ( $\text{FeO} \cdot \text{Fe}_2\text{O}_3$ ) other forms of conversion from nonmagnetic to magnetic forms may also be found.
- (2) Note. Magnetic separation may also be included in the processes classified in this subclass.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 148, for similar processes wherein a fluidized bed is utilized.
- 632+, for patents wherein  $\text{Fe}_3\text{O}_4$  is made from a relatively pure starting material.
- SEE OR SEARCH CLASS:
- 209, Classifying, Separating, and Assorting Solids, appropriate subclasses, especially subclasses 38 through 40 and 212-232, for processes and apparatus for magnetic separating of materials, including ores, where no chemical change takes place.
- 152** This subclass is indented under subclass 151. Processes wherein the temperature or range thereof at which the conversion is made is recited specifically.
- 153** This subclass is indented under subclass 138. Processes including the step of removing at least some sulfur from the mixture.
- 154** This subclass is indented under subclass 153. Processes wherein the temperature or range thereof at which the sulfur removal takes place is specifically recited.
- 155** This subclass is indented under subclass 1. Processes wherein the compound comprises one of the metals belonging to the group known as the alkaline earth metals, i.e., magnesium, calcium, strontium or barium, or the Group 11A metals of the periodic system except for beryllium and radium.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 2+, for a process of obtaining a radium compound from a mixture.
- 111+, for a process of obtaining a beryllium compound from a mixture.
- SEE OR SEARCH CLASS:
- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing Mg, Ca, Sr, or Ba.
- 156** This subclass is indented under subclass 155. Processes which include the step of attracting a component or portion of the mixture by means of magnetic lines of force to effect a separation.
- 157** This subclass is indented under subclass 155. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.
- 157.2 Phosphate rock or ore:**  
This subclass is indented under subclass 155. Processes wherein the initial mixture is a naturally formed aggregate material of earth in the form of rock or ore containing phosphate.

- 157.3 Acid treatment:**  
This subclass is indented under subclass 157.2. Processes wherein the mixture is treated with an acid.
- 157.4 Sulfating:**  
This subclass is indented under subclass 157.3. Processes in which the treatment includes the step of chemically forming a compound containing the sulfate,  $(\text{SO}_4)^{-2}$ , radical.
- (1) Note. Included in this subclass are treatments with materials such as sulfuric acid and  $(\text{SO}_4)^{-2}$  salts.
- 157.5 Phosphorous or phosphorous compound containing waste as feed:**  
This subclass is indented under subclass 155. Processes wherein the mixture treated is a by-product or discarded product of another process.
- 158** This subclass is indented under subclass 155. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 159** This subclass is indented under subclass 158. Processes wherein a chemical reaction takes place while the pressure on the mixture is either higher or lower than atmospheric; or while steam or water vapor is brought into contact with the mixture.
- (1) Note. Pressure increase or decrease can be effected by any means, e.g., submerged blast of a gas into a liquid or a slurry, pumping of the liquid or slurry, increase or decrease on pressure of the gas space above a liquid surface.
- 160** This subclass is indented under subclass 158. Processes wherein the mixture is agitated or vibrated while a chemical reaction is taking place.
- (1) Note. Agitation or vibration can be effected by any means, e.g., fluid, mechanical or sonic, etc.
- 161** This subclass is indented under subclass 158. Processes in which a specific particle size is either employed or formed.
- (1) Note. The particle size may be specified in any way, e.g., mesh size, dimension, etc., and may be formed or employed in any process step prior, during or subsequent, to a chemical reaction.
- 162** This subclass is indented under subclass 158. Processes including the step of chemically forming a compound which contains the nitrate  $(\text{NO}_3^-)$  radical or the ammonium  $(\text{NH}_4^+)$  radical.
- 163** This subclass is indented under subclass 158. Processes including the step of chemically forming a compound containing a halogen.
- 164** This subclass is indented under subclass 158. Processes including the step of chemically forming a hydroxide or a hydrate.
- 165** This subclass is indented under subclass 158. Processes including the step of chemically forming a compound having the carbonate  $(\text{CO}_3^{2-})$  radical.
- 166** This subclass is indented under subclass 158. Processes including the step of chemically forming a compound having the sulfate  $(\text{SO}_4^{2-})$  radical.
- 167.1 Treating asbestos:**  
This subclass is indented under subclass 155. Processes wherein the mixture treated has asbestos, a native magnesium calcium silicate (e.g., chrysotile, crocidolite and amosite).
- 168** This subclass is indented under subclass 155. Processes wherein a combustible fuel material is mixed with the raw or original mixture.

- 169** This subclass is indented under subclass 155. Processes wherein the original mixture includes magnesium and calcium and wherein each is separated from the other.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
158+, for processes of separating magnesium and calcium from each other by forming an insoluble substance in a liquid.
- 170** This subclass is indented under subclass 155. Processes in which the original mixture contains a metal sulfate.
- 171** This subclass is indented under subclass 170. Processes wherein at least some of the water of hydration is removed from gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) by applying heat.
- (1) Note. Usually gypsum or calcium sulfate dehydrate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) is calcined to obtain plaster of Paris or calcium sulfate hemihydrate ( $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$ ).
- 172** This subclass is indented under subclass 171. Processes in which the heat for removing the water of hydration is supplied by steam or water vapor, or the particular heating temperature, or range thereof, is specified.
- 173** This subclass is indented under subclass 155. Processes wherein the original mixture contains the carbonate of an alkaline earth metal.
- (1) Note. Limestone, magnetite, oyster shells, etc., are assumed to be impure since they are naturally occurring carbonates. Patents which claim treating calcium carbonate which is disclosed as being limestone, for example, are classified here. Processes for treating dolomite or oyster shells are classified here when no separation of the calcium and magnesium from each other is made.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
169, for treating impure carbonates, such as dolomite, to separate magnesium and calcium from each other, and subclass 167, for treating phosphate rock which contains some calcium carbonate.
- 174** This subclass is indented under subclass 173. Processes including the step of chemically forming calcium carbide ( $\text{CaC}_2$ ).
- 175** This subclass is indented under subclass 173. Processes which include the step of heating the impure carbonate.
- (1) Note. The end result of calcining an impure carbonate is usually the oxide due to driving off the carbon dioxide ( $\text{CO}_2$ ).
- 176** This subclass is indented under subclass 175. Processes wherein the mixture is subjected to a pressure below atmospheric or the heat is supplied by steam or water vapor.
- 177** This subclass is indented under subclass 175. Processes including the step of agitating or vibrating the mixture while it is being heated or in which a particular heating temperature or range thereof is specified.
- 178** This subclass is indented under subclass 155. Processes wherein the original mixture contains a halogen or sulfur.
- 179** This subclass is indented under subclass 1. Processes wherein the compound comprises one of the metals belonging to the group known as the alkali metals, i.e., lithium, sodium, potassium, rubidium or cesium or the metals of Group 1A of the periodic system except for francium.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste being volatilized and containing Li, Na, K, Rb, and Cs.
- 179.5 Lithium:**  
This subclass is indented under subclass 179. Processes wherein the metal has atomic number 3.

- 180** This subclass is indented under subclass 179. Processes wherein the mixture is an amalgam or another alloy of two or more metals.
- (1) Note. Amalgams and alloys are considered mixtures for the purposes of this class.
- 181** This subclass is indented under subclass 179. Processes which include the step of (1) attracting and retaining a component of the mixture by contact with an ion exchange substance or (2) selectively dissolving a component in one of two immiscible liquids to effect a separation; see Glossary.
- 182** This subclass is indented under subclass 179. Processes in which the alkali metal is contained in a solution used in a process, and has become ineffective to properly function in such a process because of dilution, impurities or other reason, and the solution is then regenerated or rehabilitated to approximately its original state or condition.
- (1) Note. The purpose of the processes classified here is merely regeneration. A process for another purpose which includes the subcombination of regenerating a solution is classified with the more comprehensive process. The solutions treated here are generally those used to react with an organic substance such as wood pulp and petroleum.
- 183** This subclass is indented under subclass 182. Processes wherein the solution contains hydroxide (OH<sup>-</sup>) ions.
- 184** This subclass is indented under subclass 179. Processes wherein a liquid or slurry is treated to form a substance which is insoluble therein and comes out of solution, or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein, so the insoluble substance can be separated from the liquid and the materials which remain soluble in the liquid.
- (1) Note. Crystallization of a substance is included under this definition of insolubilization.
- 185** This subclass is indented under subclass 184. Processes including the step of (1) chemically forming a compound having fluorine therein, (2) using fluorine in any form as a reactant or (3) treating the mixture to remove fluorine therefrom.
- 186** This subclass is indented under subclass 184. Processes including the step of chemically forming a compound having the carbonate (CO<sub>3</sub><sup>2-</sup>) radical.
- 187** This subclass is indented under subclass 186. Processes wherein a compound containing nitrogen is formed, is reacted or is in contact with the mixture during at least part of the process.
- 188** This subclass is indented under subclass 186. Processes wherein a reaction takes place while the pressure on the mixture is either higher or lower than atmospheric, or wherein steam or water vapor is brought into contact with the mixture.
- (1) Note. Pressure increase or decrease can be effected by any means; e.g., submerged blast of a gas into a liquid or a slurry, pumping of the liquid or slurry, increase or decrease in pressure of the gas space above a liquid surface, etc.
- 189** This subclass is indented under subclass 186. Processes including the step of reacting carbon dioxide (CO<sub>2</sub>) with at least part of the mixture.
- 190** This subclass is indented under subclass 189. Processes wherein the original mixture contains a metallic chloride compound.
- 191** This subclass is indented under subclass 186. Processes including the step of chemically forming a compound containing a halogen.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
185, for similar processes wherein the halogen is fluorine.
- 192** This subclass is indented under subclass 186. Processes including the step of chemically forming a hydroxide or a hydrate.

- 193** This subclass is indented under subclass 186. Processes including the step of chemically forming a compound containing the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- 194** This subclass is indented under subclass 184. Processes wherein a compound containing nitrogen is formed, is reacted, or is in contact with the mixture during at least part of the process.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
187, above for similar processes including carbonation.
- 195** This subclass is indented under subclass 184. Processes wherein a reaction takes place while the pressure on the mixture is either higher or lower than atmospheric; or wherein steam or water vapor is brought in contact with the mixture.
- (1) Note. Pressure increase or decrease can be effected by any means, e.g., submerged blast of a gas into a liquid or a slurry, pumping of the liquid or slurry, increase or decrease in pressure of the gas space above a liquid surface, etc.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
188, above for similar processes which include carbonation.
- 196** This subclass is indented under subclass 184. Processes in which a chemical reaction takes place while the mixture is agitated or vibrated.
- (1) Note. Agitation or vibration can be effected by any means, e.g., fluid, mechanical or sonic etc.
- 197** This subclass is indented under subclass 184. Processes including the step of chemically forming a compound containing a halogen.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
185, above for similar processes wherein the halogen is fluorine and subclass
- 191 for similar processes which include carbonation.
- 198** This subclass is indented under subclass 184. Processes including the step of chemically forming a hydroxide or a hydrate.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
192, for similar processes which include carbonation.
- 199** This subclass is indented under subclass 184. Processes including the step of chemically forming a compound having the sulfate radical ( $\text{SO}_4^{2-}$ ).
- 200** This subclass is indented under subclass 179. Processes including the step of causing an alkali metal in either the element or compound form to pass into a vapor; see Glossary.
- 201** This subclass is indented under subclass 179. Processes wherein the mixture is agitated or vibrated while being heated or while a reaction is occurring.
- (1) Note. Agitation or vibration may be effected by any means, e.g., fluid, mechanical or sonic, etc.
- 202** This subclass is indented under subclass 179. Processes including the step of using a compound which yields hydrogen ( $\text{H}^+$ ) ions in solution and gives a pH of below 7, such as an acid or acid salt, e.g.,  $\text{NaHSO}_4$ , etc.
- 203** This subclass is indented under subclass 179. Processes wherein the reaction or heating takes place while the pressure on the mixture is either higher or lower than atmospheric, or wherein steam or water vapor is brought in contact with the mixture.
- (1) Note. Pressure increase or decrease can be effected by any means, e.g., submerged blast of a gas into a liquid or slurry, pumping of the liquid or slurry, increase or decrease in pressure of the gas space above a liquid surface, etc.

- 204** This subclass is indented under subclass 203. Processes wherein the original mixture contains an organic impurity.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
182+, for a process which includes a step of regenerating or rehabilitating a solution, usually containing an organic impurity to obtain or recover alkali metal.
- 205** This subclass is indented under subclass 203. Processes including the step of dissolving out part of a solid, or chemically forming a substance while is soluble in water; see Glossary for leaching.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
202, for processes which include the step of leaching with an acidic substance.
- 206.1 Mixture contains organic or carbonaceous impurity:**  
This subclass is indented under subclass 179. Processes wherein the original mixture has an organic or a carbon containing impurity.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
182+, for processes which include regeneration of an alkali metal containing solution which also contains an organic impurity.
- SEE OR SEARCH CLASS:  
162, Paper Making and Fiber Liberation, subclass 30.11 for processes intended to treat paper making liquor.
- 206.2 Alkali carbonate from trona:**  
This subclass is indented under subclass 206.1. Processes wherein the original mixture contains trona; i.e., an ore characterized by containing sodium carbonate.
- 207** This subclass is indented under subclass 206.1. Processes including combusting the organic or carbonaceous impurity.
- 208** This subclass is indented under subclass 179. Processes including the step of dissolving out a portion of a solid with water as a solvent, or forming a substance which is soluble in water; see Glossary for leaching.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
179, for processes which include the step of leaching with water containing other materials, e.g., brine etc.  
202, for processes which include the step of leaching with an acidic substance.  
205, for processes which include leaching or forming a water soluble substance and additionally employ pressure, vacuum, or steam.
- 209** This subclass is indented under subclass 179. Processes including the step of chemically forming a compound having the carbonate ( $\text{CO}_3^{2-}$ ) radical.
- 210** This subclass is indented under the class definition. Processes in which an initial gaseous or vaporous mixture is treated so as to remove therefrom or change to a different chemical form at least one of the components therein, resulting in a heterogeneous composition.
- (1) Note. As between coordinate subclasses distinguished by specified chemical components, the original placement of a patent is in the first appearing subclass providing for a component which has been chemically modified.
- (2) Note. A chemical reaction must be involved in the process.
- (3) Note. Wherever the recovery of a definite chemical compound or element as a product is claimed, original classification of the patent is in the subclass following subclass 215.5 which provides for the compound or element. However, where the claim does not include the step of separating the modified component, the patent is classified here (subclasses 210+) even though disclosed intent is to ultimately effect separation of the component.

- (4) Note. The mixture need not be entirely gaseous; it may contain entrained solids or liquids. It must however be handled and distributed as a gas and must be in this form at the onset of the treatment.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 264, for rendering an impurity ineffective in a process in which either the starting mixture is not gaseous, or if gaseous, the intent is to make a compound; see preceding notes.

**SEE OR SEARCH CLASS:**

- 95, Gas Separation: Processes, appropriate subclasses, for processes of purifying a gaseous mixture or separating a constituent therefrom where no chemical reaction is involved in the separation or purification, per se. In this respect sorption on a solid (e.g., silica gel, charcoal etc.) or in water even of gases such as  $\text{NH}_3$ ,  $\text{SO}_3$ , etc. which may form alkalis or acids with the water is considered to be a nonchemical separation proper for Class 95. However, adsorption on a basic or acidic solid, or absorption in acid or a base is considered to be a chemical reaction and proper for Class 423, subclasses 210+, unless the acid or base is the solvent for itself, i.e., hydrochloric acid for gaseous hydrogen chloride, sulfuric acid for sulfur trioxide, etc.
- 102, Ammunition and Explosive, subclass 23, for blasting methods which include procedures for fume control.
- 149, Explosive and Thermic Compositions or Charges, subclass 108.4 for subject matter of that class drawn to control of the smoke or gas produced.
- 260, Chemistry of Carbon Compounds, appropriate subclasses for preparation and treatment of organic materials.
- 431, Combustion, for processes of burning exhaust gases where the intent is to

use the gas as a fuel primarily and not to separate or purify the gas. Note subclass 224 in Class 423 where combustion is used to purify or separate a gas.

- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for treatment of gaseous, hazardous, or toxic waste.

- 210.5** This subclass is indented under subclass 210. Processes in which the treatment includes the direct contact between the gaseous mixture and a material in the molten state.

- (1) Note. Molten material for this defines only those substance, which are solid at ambient conditions but have been rendered liquid by a change in conditions.

- 212** This subclass is indented under subclass 210. Processes in which the initial gaseous mixture is the exhaust from an internal combustion engine.

**SEE OR SEARCH CLASS:**

- 60, Power Plants, subclasses 272 through 308 for exhaust gas treatment in cooperation with engine function.
- 422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclasses 168+ for apparatus for purifying exhaust gases from an internal combustion engine in which apparatus a catalyst is employed.

- 213.2** This subclass is indented under subclass 212. Processes, in which the material used to treat the gaseous mixture is in the solid-state and comprises a transition element, or compound thereof, and which functions to (1) modify a component, or (2) attract and retain a component, or (3) react with and chemically change a component.

- (1) Note. The transition elements are those having atomic numbers of 21 through 30, 39 through 48, 57 through 80, 89 through 103.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

212, for a process of treating the gaseous which the treating material, if a solid catalyst, sorbent or reactant, does not contain a transition element.

**213.5** This subclass is indented under subclass 213.2. Processes in which the transition element is one which appears in Group VIII of the Periodic Table.

**213.7** This subclass is indented under subclass 213.2. Processes in which there are at least two serial treatments of the gaseous mixture, each treatment modifying or removing a component different than that affected by the other.

**215.5** This subclass is indented under subclass 210. Processes in which the component removed is in the solid-state in the gaseous mixture.

(1) Note. The solid component is usually particulate in form and may be foreign matter (e.g., dust), or a chemical element or compound.

(2) Note. The usual method of removing a solid component from a gas stream is by physical means, e.g., filtering, washing, deflecting, electrostatic precipitating, etc. However, a chemical reaction is required with the solid component for placement of a patent in this Class 423; see search note following for separating a gaseous mixture by physical means only.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, appropriate subclasses, for separating a gas mixture by mere physical means, e.g., filtering, deflecting, electrostatic precipitating, washing with liquid, etc. where no chemical reaction is involved.

**219** **Molecular oxygen or ozone component:**  
This subclass is indented under subclass 210. Processes in which the component is oxygen in a molecular form or ozone.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

210, for processes for removing ozone from a gaseous mixture.

217+, for processes for removing molecular oxygen from atmospheric air.

**220** This subclass is indented under subclass 210. Processes wherein the component is carbon dioxide (CO<sub>2</sub>) or hydrogen sulfide (H<sub>2</sub>S).

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating carbon dioxide (CO<sub>2</sub>) or hydrogen sulfide (H<sub>2</sub>S) from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for solid sorption, and subclasses 149+ for liquid contacting.

**221** This subclass is indented under subclass 220. Processes in which the material used to treat the gaseous mixture comprises a thionate or thiosulfate compound (S<sub>2</sub>O<sub>3</sub><sup>2-</sup>).

**222** This subclass is indented under subclass 220. Processes in which the material used to treat the gaseous mixture comprises sulfur dioxide or a solution thereof or a sulfite (SO<sub>3</sub><sup>2-</sup>) or bisulfite (HSO<sub>3</sub>.) compound.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

574+, for processes including the step of reacting hydrogen sulfide with sulfur dioxide.

**223** This subclass is indented under subclass 220. Processes in which the material used to treat the gaseous mixture comprises arsenic, phosphorus or boron or compounds thereof.

(1) Note. Catalysts containing arsenic, boron or phosphorus are not included under this definition of reactant.



- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 230+, for a process in which the gaseous mixture is treated with a catalyst or sorbent which may contain arsenic, phosphorous or boron.
- 224** This subclass is indented under subclass 220. Processes in which the component is removed or changed by causing (1) it to combine with oxygen, or to produce a flame, or (2) the augmentation of the valence number of an ion or atom thereof as the result of the loss of negative charges as electrons thereby making it more electropositive.
- (1) Note. Excluded from this subclass is a process in which a sorbent containing the removed constituent is revived or regenerated by treating with an oxidizing gas. For such a step, see subclasses 221, 222, or 233.
- SEE OR SEARCH CLASS:  
 431, Combustion, subclasses 2+ for processes of burning a gas for use as a fuel.
- 225** This subclass is indented under subclass 220. Processes in which the material used to treat the gaseous mixture comprises solid particles of an oxide or hydroxide of a metal dispersed throughout a liquid vehicle.
- 226** This subclass is indented under subclass 220. Processes in which the material used to treat the gaseous mixture comprises an organic compound, at least in part.
- (1) Note. An organic compound under this definition is as defined in the definition of Class 260, Chemistry of Carbon Compounds, as qualified by (34) Note therein.
- (2) Note. The organic part may be present as the organic radical part of a compound or as the organic portion of a mixture of organic and inorganic materials.
- 227** This subclass is indented under subclass 226. Processes wherein the compound has an aromatic nucleus in which at least one of the hydrogen atoms has been replaced by a hydroxyl group.
- 228** This subclass is indented under subclass 226. Processes wherein the organic compound is one derived from ammonia by substituting an organic radical for at least one of the hydrogens.
- 229** This subclass is indented under subclass 228. Processes in which an aminoalcohol substituent is ethanol.
- 230** This subclass is indented under subclass 220. Processes in which the treating material is in the solid-state and functions to (1) modify a component, (2) attract and retain the component, or (3) react with and chemically change the constituent.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 223, for a process in which the reactant contains arsenic, phosphorus or boron and may be in the solid-state.  
 225, for a process in which the solid sorbent, reactant or catalyst is used in the form of a suspension in a liquid in the process.
- 231** This subclass is indented under subclass 230. Processes in which the solid treating material includes an oxide or hydroxide of iron.
- 232** This subclass is indented under subclass 220. Processes in which the treating material comprises a carbonate ( $\text{CO}_3^{2-}$ ) or bicarbonate ( $\text{HCO}_3^-$ ) compound in solution.
- 233** This subclass is indented under subclass 232. Processes in which the material is revived after being used by being contacted with a gas to cause the constituent to be separated or removed therefrom so that the material may again be used to treat the gaseous mixture.
- 234** This subclass is indented under subclass 220. Processes in which the gaseous mixture in contacted with a treating material comprising the hydroxide of a metal or of ammonium, is solution.

- 235** This subclass is indented under subclass 210. Processes in which the component is molecular nitrogen or a nitrogen-containing compound.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

217, for a process of removing molecular nitrogen from atmospheric air.

- 236** This subclass is indented under subclass 235. Processes in which the component is a compound containing nitrogen and carbon atoms.

(1) Note. Examples of such carbon containing nitrogen compounds are cyanogen chloride or hydrocyanic acid.

- 237** This subclass is indented under subclass 235. Processes in which the component is ammonia (NH<sub>3</sub>).

SEE OR SEARCH THIS CLASS, SUB-CLASS:

236, for processes of separating ammonia from a gas mixture which also includes a carbon containing nitrogen compound (e.g., a mixture of ammonia and hydrogen cyanide).

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating ammonia from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for solid sorption, and subclasses 149+ for liquid contacting.

- 238** This subclass is indented under subclass 237. Processes in which the ammonia is removed or changed by means of a reactant in the liquid state.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

279+, 286+, 305+, 352+, 396, 420, 470+, 517, 545+, 593+, for processes of preparing an ammonium compound from a gas where it is clear that the main intent is to use the gas as the feedstock source of the ammonia and not to purify the gas.

**239.1 Utilizing solid sorbent, catalyst, or reactant:**

This subclass is indented under subclass 235. Process in which the treating material is a solid and functions to (a) modify a component, (b) attract and retain a component, or (c) react with and chemically change a component.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

212, for processes which remove nitrogenous components from internal engine exhaust.

230, for processes using a solid sorbent, catalyst, or reactant to separate carbon dioxide or hydrogen sulfide in a gaseous mixture.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating nitrogen (N<sub>2</sub>) or nitrogen containing compounds from a gaseous fluid mixture by physical means only; particularly, subclasses 90+ for solid sorption, per se.

**239.2 Zeolite:**

This subclass is indented under subclass 239.1. Process in which the treating material contains a zeolite.

- 240** This subclass is indented under subclass 210. Processes in which the component is a halogen containing material.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating a halogen from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for solid sorption, and subclasses 149+ for liquid contacting.

- 241** This subclass is indented under subclass 240. Processes in which the component is free or molecular halogen.

(1) Note. The constituent must be initially present in the gaseous mixture in the free or molecular form may be removed as such, or may be combined prior to removal or discharge.

**242.1 Sulfur or sulfur containing component:**

This subclass is indented under subclass 210. Processes in which the component is sulfur or a compound thereof.

SEE OR SEARCH THIS CLASS, SUBCLASS:

200+, for separation and purification of a gaseous mixture in which the sulfur is present as hydrogen sulfide.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating sulfur (S) or a compound thereof from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for solid sorption, and subclasses 149+ for liquid contacting.

**242.2 Utilizing reactant having organic portion to remove or modify sulfur or sulfur containing component:**

This subclass is indented under subclass 242.1. Process wherein the sulfur or sulfur containing component is removed or changed by treatment with a reactant, a portion of which is an organic compound radical.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, appropriate subclasses, for processes of physically separating sulfur or a compound thereof from a gaseous fluid mixture.

**242.3 Organic acid:**

This subclass is indented under subclass 242.2. Process wherein the reactant is an organic acid (i.e., a compound containing -COOH).

**242.4 Alcohol, arylhydroxide, or polyol:**

This subclass is indented under subclass 242.2. Process wherein the organic portion is an alcohol, an aryl radical, or an organic radical having one or a plurality of hydroxyl groupings (i.e., (OH)<sup>-1</sup>).

**242.5 Sugar:**

This subclass is indented under subclass 242.2. Process wherein the organic portion is a radical from a sweet carbohydrate, having a gen-

eral formula of C<sub>N</sub>H<sub>2N</sub>O<sub>N</sub> or C<sub>N</sub>H<sub>2N-2</sub>O<sub>N-1</sub> (e.g., sucrose).

**242.6 Heterocyclic:**

This subclass is indented under subclass 242.2. Process wherein the reactant contains an organic ring portion having a dissimilar atom (e.g., S or N) in the ring.

**242.7 Amine:**

This subclass is indented under subclass 242.2. Process wherein the nitrogen containing reactant is an amine (i.e., NR<sub>3</sub> grouping wherein at least one of the R groups is an organic radical).

**243.01 Utilizing aqueous reactant to remove or modify sulfur containing component:**

This subclass is indented under subclass 242.1. Process wherein the sulfur or sulfur containing component is removed or changed by treatment with a reactant dissolved in or contained in water (e.g., solution or slurry).

**243.02 And addition of gaseous reactant:**

This subclass is indented under subclass 243.01. Process wherein a reactant is added that is in a gaseous state at ambient condition (e.g., NH<sub>3</sub>, Cl<sub>2</sub>).

(1) Note. Excluded from this subclass are those liquid reactants that have been formed by dissolved gases such as NH<sub>4</sub>OH that have no specifically recited undissolved gaseous component.

SEE OR SEARCH THIS CLASS, SUBCLASS:

243.10, for those added components dissolved and forming ionic reactants, such as NH<sub>4</sub>OHNH<sub>4</sub><sup>+</sup> OH<sup>-</sup> in alkali or alkaline earth slurry or solution.

**243.03 Oxygen:**

This subclass is indented under subclass 243.02. Process wherein the gaseous reactant includes elemental oxygen.

(1) Note. Elemental oxygen includes oxygen combined only with itself, such as free oxygen (O<sub>2</sub>) and ozone (O<sub>3</sub>), but does not include oxygen chemically combined with any other elements or

compounds such as carbon monoxide (CO).

**243.04 Ion separation step:**

This subclass is indented under subclass 243.01. Process wherein the treatment takes place by immediate reaction with a product of an ionic separation process, (i.e., dialysis, either by separation using a semipermeable membrane or by electrolysis).

**SEE OR SEARCH CLASS:**

210, Liquid Purification or Separation, subclasses 600+ for processes of ion separation where a reagent does not immediately react with a product of the separation wherein the intent is to purify a liquid.

**243.05 With component added to inhibit corrosion or scaling of processing apparatus:**

This subclass is indented under subclass 243.01. Process wherein the treatment includes addition of a reactive component whose function is specified to restrain or stop corroding or scaling of processing equipment.

**SEE OR SEARCH CLASS:**

252, Compositions, subclasses 387+ for corrosion preventing or anti-corrosive agents.  
422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclasses 7+ for processes of maintaining an environment non-destructive to metal.

**243.06 Ammonium compound reactant:**

This subclass is indented under subclass 243.01. Process wherein the reactant contains an ammonium (NH<sub>4</sub>)<sup>+1</sup> radical.

**243.07 Transition metal or compound thereof reactant:**

This subclass is indented under subclass 243.01. Process wherein the reactant is a transition metal or a compound thereof.

**243.08 Alkali or alkali earth compound reactant:**

This subclass is indented under subclass 243.01. Process wherein the reactant is an alkali or alkaline earth compound.

**243.09 Sulfite:**

This subclass is indented under subclass 243.08. Process wherein the alkaline component contains a sulfite radical (SO<sub>3</sub>)<sup>-2</sup>.

**243.1 And additional ionic reactant:**

This subclass is indented under subclass 243.08. Process wherein the reactant also contains a dissociated ionic reactant other than the alkali or the alkaline earth compound reactant.

- (1) Note. Included in this subclass are dissociated ionic components that take part in a reaction that removes or changes the sulfur containing component.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

265+, for processes of using additives which do not take part in the reaction, but which serve to improve, protect, or modify a product produced by a separate and distinct reaction.  
270+, for additives specifically added when the product is sulfur trioxide.

**243.11 And subsequent reactive treatment to remove sulfur from spent reactant:**

This subclass is indented under subclass 243.01. Process wherein the reactant, after removing or changing the sulfur or sulfur containing component from the gaseous mixture, is subjected to a further reactive treatment wherein sulfur or a sulfur containing component is removed from the reactant.

- (1) Note. This subclass contains processes for removing or recovering a sulfur or sulfur containing component.

**SEE OR SEARCH CLASS:**

95, Gas Separation: Processes, subclasses 149+, for gas separation processes including liquid contacting to remove sulfur or a compound thereof and regenerating of the liquid.

**243.12 Gaseous treatment:**

This subclass is indented under subclass 243.11. Process wherein further reactive treatment is with a reactant in a gaseous state.

**244.01 Utilizing solid reactant or catalyst to remove or modify sulfur or sulfur containing component:**

This subclass is indented under subclass 242.1. Process wherein the sulfur or sulfur containing component is removed or changed by treatment with a reactant or catalyst that is in a solid-state.

**244.02 Reactant or catalyst on support:**

This subclass is indented under subclass 244.01. Process wherein the reactant or catalyst is positioned in contact with a supporting material.

**244.03 Carbonaceous support:**

This subclass is indented under subclass 244.02. Process wherein the support is composed of a carbon containing material (e.g., activated carbon).

**244.04 Aluminosilicate support:**

This subclass is indented under subclass 244.02. Process wherein the support is composed of a material containing a compound of aluminum, oxygen, and silicon.

**244.05 Reactant added to fuel for reaction in gas mixture:**

This subclass is indented under subclass 244.01. Process wherein the reactant is added to a mixture consumed to produce energy.

**244.06 Transition metal or compound thereof reactant:**

This subclass is indented under subclass 244.01. Process wherein the reactant is a transition metal or a compound thereof.

**244.07 Alkali or alkaline earth compound reactant:**

This subclass is indented under subclass 244.01. Process wherein the reactant is a compound that contains an alkali metal or alkaline-earth metal.

**244.08 Carbonate:**

This subclass is indented under subclass 244.07. Process wherein the compound contains a carbonate radical (i.e.,  $(\text{CO}_3)^{-2}$ ).

**244.09 Catalyst:**

This subclass is indented under subclass 244.01. Process wherein the sulfur or sulfur containing component is treated with a catalyst present.

**244.1 Transition metal or compound thereof catalyst:**

This subclass is indented under subclass 244.09. Process wherein the catalyst includes a transition metal or a compound thereof.

**244.11 Zeolite containing:**

This subclass is indented under subclass 244.09. Process wherein the catalyst contains a zeolite.

**SEE OR SEARCH CLASS:**

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, appropriate subclasses for zeolites specifically structured to catalyze a component.

**245.1 Organic component:**

This subclass is indented under subclass 210. Process wherein the component is an organic compound, at least in part.

(1) Note. See subclass 226 (1) Note for the structural requirement of an organic compound.

(2) Note. The phase of the modifying or removing agent that reacts with the organic component is what determines whether classification is proper in subclass 245.1, subclass 245.2, or substrate wetted with an aqueous hydrogen peroxide removing agent is properly classified in subclass 245.2. Removing agents comprising gases or solids dissolved in liquids are considered to be liquid reactants.

**SEE OR SEARCH CLASS:**

95, Gas Separation: Processes, for processes of separating an organic compound from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for

solid sorption, and subclasses 149+ for liquid contacting.

**245.2 Utilizing liquid reactant:**

This subclass is indented under subclass 245.1. Process wherein a liquid reactant is utilized to modify or remove the organic component.

**245.3 By burning or catalytically combusting component:**

This subclass is indented under subclass 245.1. Process wherein the organic component is either burned or catalytically combusted using oxygen, air, ozone, or a mixture thereof.

**246** This subclass is indented under subclass 210. Processes wherein the component is carbon monoxide.

SEE OR SEARCH THIS CLASS, SUBCLASS:

212+, for a process for separating or removing constituents from the exhaust of an internal combustion engine, one of which constituents may be carbon monoxide.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating carbon monoxide (CO) from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for solid sorption, and subclasses 149+ for liquid contacting.

**247** This subclass is indented under subclass 246. Processes in which the treating material is in the solid-state and functions to (1) modify a component, (2) attract and retain a component or (3) react with and chemically change a constituent.

SEE OR SEARCH THIS CLASS, SUBCLASS:

212+, for a process in which a solid sorbent, catalyst or reactant is used to separate or remove carbon monoxide from the exhaust of an internal combustion engine.

223, for a process of treating a gaseous mixture to separate or purify carbon dioxide or hydrogen sulfide with a

reactant containing boron, phosphorus or arsenic, which reactant may be in the solid-state.

230+, 239 and 244 for processes for separating or purifying a gaseous mixture by using a solid catalyst, sorbent or reactant where a constituent is carbon dioxide or hydrogen sulfide, nitrogen or a nitrogenous compound or sulfur or a compound thereof respectively.

**248** This subclass is indented under subclass 210. Processes wherein the component is hydrogen in molecular form.

SEE OR SEARCH THIS CLASS, SUBCLASS:

246+, for processes of removing or separating carbon monoxide from a mixture thereof with hydrogen thus leaving pure hydrogen.

SEE OR SEARCH CLASS:

95, Gas Separation: Processes, for processes of separating hydrogen from a gaseous fluid mixture by physical means only. See particularly subclasses 43+ for selective diffusion of gases, subclasses 90+ for solid sorption, and subclasses 149+ for liquid contacting.

**249** This subclass is indented under the class definition. Products, or processes for making such products, which exhibit spontaneous nuclear disintegration with emission of radioactive particles and which comprises (1) the compound of an element which is naturally unstable and has an atomic number of at least 84, (2) compound of an element which has been treated to render an isotope thereof radioactive or (3) a nonmetallic element which is naturally or has been treated to make it or an isotope thereof radioactive; see Glossary.

(1) Note. In this subclass will be found radon, astatine, or compounds thereof.

(2) Note. Compounds, of the trans-actinide elements i.e., those having atomic numbers greater than 103, will be found in this group of subclasses.

- (3) Note. Patents wherein the claims are directed to making an element radioactive or to making a different isotope of a radioactive element are classified in Class 376, Induced Nuclear Reactions: Processes, Systems, and Elements, subclasses 156+ even when the element is in compound form.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
2+, for a process of treating a mixture to recover therefrom a compound of a radioactive metal.
- 250** This subclass is indented under subclass 249. Products or processes in which the compound comprises an element having an atomic number of 93 or greater.
- 251** This subclass is indented under subclass 250. Products or processes in which the compound comprises plutonium.
- 252** This subclass is indented under subclass 249. Products or processes in which the compound comprises thorium.
- 253** This subclass is indented under subclass 249. Products or processes which the compound comprises uranium.
- 254** This subclass is indented under subclass 253. Products or processes in which the compound consists of uranium and only one other elements.
- 255** This subclass is indented under subclass 254. Products or processes in which the other element is hydrogen.
- 256** This subclass is indented under subclass 254. Products or processes in which the other element is carbon.
- 257** This subclass is indented under subclass 254. Products or processes in which the other element is chlorine.
- 258** This subclass is indented under subclass 254. Products or processes in which the other element is fluorine.
- 259** This subclass is indented under subclass 258. Products or processes in which the binary compound is uranium tetrafluoride (UF<sub>4</sub>).
- 260** This subclass is indented under subclass 254. Products or processes in which the other element is oxygen.
- 261** This subclass is indented under subclass 260. Products or processes in which the binary compound is uranium dioxide (UO<sub>2</sub>).
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
16, for a process of treating a mixture containing uranium to recover uranium tetraoxide or peroxide, UO<sub>4</sub> which process includes the step of precipitating a compound out of solution.
- 262** This subclass is indented under the class definition. Products or processes in which the product is a noble or inert gas having atomic nos. 2, 10, 18, 36, or 54, or a compound thereof; the gas being a member of the “zero” group of the periodic table, having no valency and combining with other elements only with difficulty.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
249, for radon (atomic no. 86), which is the radioactive member of the noble or inert gases, or a compound thereof.
- 263** This subclass is indented under the class definition. Products or processes in which the product is a compound of a metal which is a member of the “rare earth” or lanthanide series and which has an atomic number of 21, 39, or 57 through 71.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
21.1+, for a process of treating a mixture containing a rare earth metal to obtain a compound of the metal.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or contain-

ment of hazardous or toxic waste containing rare earth or lanthanide elements (atomic numbers 21, 39, or 57-71).

**264** This subclass is indented under the class definition. Processes in which a compound whose color is, or would be, adversely affected by an impurity therein, is treated to chemically modify the impurity and thus improve the color.

- (1) Note. Sometimes it is not economically feasible to remove an impurity from a compound which is to be used as a pigment, and so the impurity is changed to a nondetrimental form. For example,  $\text{Fe}_2\text{O}_3$  is changed to  $\text{Fe O}$  which does not effect the color characteristics of titanium dioxide as much as  $\text{Fe}_2\text{O}_3$  does.

**265** This subclass is indented under the class definition. Products or processes comprising a compound or a nonmetallic element physically interrelated with another substance which serves to improve, protect or modify the product, which substance does not take part in the reaction, which makes the product, but is added to the reaction or to the product or is made by a separate and distinct reaction.

- (1) Note. A catalyst or other reaction promoter is excluded under this definition of additive.
- (2) Note. If in a chemical reaction a reagent is added to combine with a portion of the reactants to form an additive by a reaction other than that which makes the desired product, classification is proper for this group of subclasses.
- (3) Note. A substance added to a feedstock to control or modify the product and is carried along in the reaction to be mixed with the product is considered to be additive for this group of subclasses. The final mixture is not considered to be proper for Class 106, Compositions: Coating or Plastic, or Class 252, Compositions unless the disclosure is clear and specific that the product is intended to be a mixture or composition for a specific utility or use. For example, in making

carbon black various substances are added to the feedstock to be carried along to the final product and to modify the properties of the carbon black, e.g., oil absorption, crystal structure, etc. These patents are properly classified in this Class 423, subclasses 265+. However, the modified carbon black when disclosed for use as a filler for rubber articles is proper for Class 106, Compositions: Coating and Plastic, subclasses 400+.

- (4) Note. Processes of preventing corrosion of metal containers or receptacles by a Class 423 product by admixing an anti-corrosion additive therewith are properly classified in Class 423, subclass 269, since this is the mere use of a product to which an anti-corrosion additive has been added, and since corrosion of the metal causes corrosion of the product. See (1) Note in Class 422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclass 7.

- (5) Note. Mixing ingredients to form a composition which is in better form for pyrometallurgy, even though some chemical reaction is involved, excluded from this Class 423 and will be found in Class 75.

- (6) Note. Class lines

A. A Class 423 product, per se, is classified in Class 423 regardless of its utility.

B. A Class 423 product admixed with an additive whose sole function (claimed or disclosed) is to otherwise perfect the product is classified in Class 423.

C. The process of making a Class 423 product and adding a preservative thereto is classified in Class 423; the process of merely adding a preservative to a Class 423 product is also classified in Class 423.

D. A Class 423 product admixed with a substance which has one utility other than preserving attributed thereto is classified in the class providing for such util-



ity if such class exists; otherwise classification is proper in Class 252, Compositions.

E. A Class 423 product admixed with a substance which has plural utilities other than preserving attributed thereto, all of which are unclaimed and such utilities are subjects matter for different classes, is proper for Class 252, Compositions.

F. A Class 423 product admixed with a preserving substance and the mixture is disclosed or claimed as having an art use is classified in the class providing for such use, e.g., table salt is properly classified in Class 426, Food or Edible Material: Processes, Compositions, and Products, a fertilizer comprising a phosphate and a preservative is proper for Class 71, Chemistry: Fertilizers.

G. The rules for determining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the section LINES WITH OTHER CLASSES AND WITHIN THIS CLASS, SUBSECTION COMPOSITION CLASS SUPERIORITY, which includes a hierarchical ORDER OF SUPERIORITY FOR COMPOSITION CLASSES.

#### SEE OR SEARCH CLASS:

- 8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, subclasses 101+ for bleaching processes under the Class 8 definition, and especially Class 107 for processes using specific chemicals.
- 71, Chemistry: Fertilizers, see (6) Note. Par. F. above.
- 106, Compositions: Coating and Plastic, see (3) Note above.
- 252, Compositions, subclasses 186.1+ for oxidative bleaching compositions, per se, and 397+ for anti oxidant and chemical change inhibiting compositions, per se. See also (6) Note. Par. E. above.
- 260, Chemistry of Carbon Compounds, for (a) carbon compounds of known and

undetermined constitution. In the situation wherein it is uncertain whether the compound is prepared by reacting two or more reactants, the original will be classified in Class 260 in accordance with the rule set forth in the Class 260 Definition (Page 260-2) (b) essential oils of undetermined constitution and their reaction products. See subclass 236.6. Single source essential oils of known constitution combined with plural ingredients having a claimed, or solely disclosed food use are classified in Class 426, Food or Edible Material: Processes, Compositions, and Products. (c) extracts of both plant and animal origin. Same rule applies as in (b) above. (d) proteins, oils and fats from a single source.

422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, see (6) Note, paragraph C above and definitions of Class 422.

424, Drug, Bio-Affecting and Body-Treating Compositions, subclass 62, for bleach compositions, per se, to be used on live hair or skin, and subclasses 613+ for compositions under the 424 class definitions containing peroxide as an active ingredient.

**266** This subclass is indented under subclass 265. Products or processes in which the compound or nonmetallic element has a crystalline form and the substance serves to attain a desired crystal shape or size or to prevent change of the desired shape or size.

#### SEE OR SEARCH CLASS:

- 23, Chemistry: Physical Processes, subclasses 295+ for processes of crystallization which involve no chemical reaction, in particular, subclasses 300+ for those processes in which an additive is employed.

**267** This subclass is indented under subclass 265. Products or processes in which the substance acts to prevent or reduce (1) the absorption of moisture into the mixture or (2) the cohering of individual particles into larger masses.

- SEE OR SEARCH CLASS:  
252, Compositions, subclasses 381+ for anti-caking agents in general.
- 268** This subclass is indented under subclass 267. Products or processes in which the substance is or includes an organic material.
- (1) Note. See subclass 226 (1) Note for structural requirement of an organic compound.
- SEE OR SEARCH CLASS:  
252, Compositions, subclass 384, for organic anti-caking agents, per se.
- 269** This subclass is indented under subclass 265. Products or processes which the substance prevents or inhibits the compound or non metallic element from eroding or eating away materials external to the product.
- SEE OR SEARCH CLASS:  
106, Compositions: Coating and Plastic, especially subclass 14.05, for compositions of the Class 106 type having a specific corrosion resisting effect beyond mere coating.  
148, Metal Treating, especially subclasses 240+ for methods of inhibiting corrosion of metals which include coating the metal with a substance which reacts with the metal.  
252, Compositions, subclasses 387+, for corrosion inhibiting compositions, per se.  
422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclasses 1+ for processes of preventing corrosion not elsewhere provided for.
- 270** This subclass is indented under subclass 265. Products or processes in which the product is sulfur trioxide (SO<sub>3</sub>).
- (1) Note. The substance is usually added for the purpose of preventing polymerization of the SO<sub>3</sub>.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
532+, for sulfur trioxide, per se, and processes for its manufacture.
- 271** This subclass is indented under subclass 270. Products or processes in which the substance is a metal, boron or silicon, or a compound thereof.
- 272** This subclass is indented under subclass 265. Products or processes which the product is hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
584+, for hydrogen peroxide and methods for making it.
- 273** This subclass is indented under subclass 272. Products or processes in which the substance is a metal, boron or silicon, or a compound thereof.
- 274** This subclass is indented under subclass 265. Products or processes in which the substance is interrelated as a (1) covering over at least part of the surface of the product or (2) a binder causing the particles of the product to adhere to one another.
- (1) Note. The coating or binder generally does not interfere, to any undue extent, with the reactivity of the product when such reactivity is desired.
- SEE OR SEARCH CLASS:  
264, Plastic and Nonmetallic Article Shaping or Treating: Processes, for briquetting or otherwise shaping the compositions of this subclass.  
424, Drug, Bio-Affecting and Body-Treating Compositions, subclasses 16+, for coated compositions meeting the Class 424 definition.  
427, Coating Processes, for general processes of coating. The process of making and coating a Class 423 product is properly classified in Class 423 where the purpose of the coating is merely to preserve or stabilize the product. The process of coating a Class 423 product is proper for Class

- 427, and a coated Class 423 product is proper for Class 423.
- 275** This subclass is indented under subclass 265. Products or processes in which the substance is a metal, boron or silicon, or a compound thereof.
- 276** This subclass is indented under the class definition. Products or processes wherein the product is boron or a compound thereof.
- 277** This subclass is indented under subclass 276. Products or processes wherein the boron compound includes oxygen.
- 278** This subclass is indented under subclass 277. Products or processes wherein the compound contains only the elements boron and oxygen.
- 279** This subclass is indented under subclass 277. Products or processes wherein the compound contains only boron, oxygen and either a metal or the ammonium radical.
- (1) Note. Under this definition the ammonium ( $\text{NH}_4^+$ ) radical is considered as only 1 element of the ternary compound; see (2) Note of the main class definition.
- 280** This subclass is indented under subclass 279. Processes which includes the use of at least one reactant in the liquid state or in solution.
- (1) Note. Included under the definition of dissolved or liquid reactant is a slurry of solids in a liquid.
- 281** This subclass is indented under subclass 280. Processes in which the reactant comprises a peroxide.
- 282** This subclass is indented under subclass 280. Processes in which the reactant comprises a compound containing the element carbon.
- 283** This subclass is indented under subclass 277. Products or processes wherein the compound contains only the three elements, boron, oxygen and hydrogen.
- 284** This subclass is indented under subclass 276. Products or processes in which the compound also contains nitrogen and hydrogen.
- 285** This subclass is indented under subclass 284. Products or processes in which the compound contains only the three elements boron, hydrogen and nitrogen.
- 286** This subclass is indented under subclass 276. Products or processes in which the compound also contains hydrogen and either a metal or the ammonium ( $\text{NH}_4^+$ ).
- 287** This subclass is indented under subclass 286. Processes which include the use of a halogen containing compound as a reactant.
- 288** This subclass is indented under subclass 286. Processes which include the use of an oxygen containing compound as a reactant.
- 289** This subclass is indented under subclass 276. Products and processes in which the compound contains boron and only one other element.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
278, for binary compounds containing boron and oxygen and methods of making such compounds.
- 290** This subclass is indented under subclass 289. Products of processes wherein the other element is nitrogen.
- 291** This subclass is indented under subclass 289. Products or processes wherein the other element is carbon.
- 292** This subclass is indented under subclass 289. Products or processes wherein the other element is a halogen.
- 293** This subclass is indented under subclass 292. Products or processes wherein the halogen is fluorine.
- 294** This subclass is indented under subclass 289. Products or processes wherein the other element is hydrogen.

- 295** This subclass is indented under subclass 294. Processes which include the step of reacting a metal containing hydride or an organic derivative thereof.
- 296** This subclass is indented under subclass 294. Processes which include the step of reacting elemental or uncombined hydrogen.
- 297** This subclass is indented under subclass 289. Products or processes wherein the other element is titanium, vanadium chromium, zirconium, niobium, molybdenum, hafnium, tantalum, or tungsten, commonly known as a refractory metal.
- 298** This subclass is indented under subclass 276. Products or processes wherein the product is elemental boron.
- 299** This subclass is indented under the class definition. Products or processes wherein the product is phosphorus or a compound thereof.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing, halogen, oxygen, sulfur, metal, and phosphorus.
- 300** This subclass is indented under subclass 299. Products or processes wherein the product contains a halogen.
- 301** This subclass is indented under subclass 300. Products or processes wherein the halogen is fluorine.
- 302** This subclass is indented under subclass 299. Products or processes wherein the product contains nitrogen.
- (1) Note. Nitrogen in the ammonium radical ( $\text{NH}_4^+$ ) is not considered nitrogen for the purpose of this subclass; see (2) Note in the class definition.
- 303** This subclass is indented under subclass 299. Products or processes wherein the product contains sulfur.
- 304** This subclass is indented under subclass 299. Products or processes wherein the product contains oxygen.
- 305** This subclass is indented under subclass 304. Products or processes wherein the product also contains a metal or the ammonium ( $\text{NH}_4^+$ ) radical.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
237+, for a process of preparing ammonium phosphate from the ammonia in gas where the main intent is to purify the gas, the recovery of the product being of secondary importance.
- 306** This subclass is indented under subclass 305. Products or processes wherein the product contains two metals or a metal and the ammonium ( $\text{NH}_4^+$ ) radical.
- 307** This subclass is indented under subclass 305. Products or processes wherein the product also contains hydrogen.
- 308** This subclass is indented under subclass 307. Products or processes wherein the product contains the orthophosphate ( $\text{PO}_4^{3-}$ ) radical.
- 309** This subclass is indented under subclass 308. Processes which include the step of reacting phosphoric acid or its anhydride.
- 310** This subclass is indented under subclass 309. Processes which include the step of reacting ammonia.
- 311** This subclass is indented under subclass 305. Products or processes wherein the product contains the orthophosphate ( $\text{PO}_4^{3-}$ ) radical.
- 312** This subclass is indented under subclass 311. Products or processes wherein the product contains lithium, sodium, potassium, rubidium, cesium or the ammonium ( $\text{NH}_4^+$ ) radical.
- 313** This subclass is indented under subclass 312. Processes which include the step of reacting phosphoric acid.

- 314 This subclass is indented under subclass 305. Products or processes wherein the product contains the meta-phosphate ( $\text{PO}_3^-$ ), ( $\text{P}_2\text{O}_6^{2-}$ ) or ( $\text{P}_6\text{O}_{18}^{6-}$ ) radical.
- 315 This subclass is indented under subclass 305. Products or processes wherein the product contains the triphosphate ( $\text{P}_3\text{O}_{10}^{5-}$ ) or the tetraphosphate ( $\text{P}_4\text{O}_{13}^{6-}$ ) radical.
- 316 This subclass is indented under subclass 304. Products or processes wherein the product contains phosphorus, oxygen and hydrogen, only.
- 317 This subclass is indented under subclass 316. Products or processes wherein the product is orthophosphoric acid ( $\text{H}_3\text{PO}_4$ ).
- 318 This subclass is indented under subclass 317. Processes which include the step of reacting silicon or carbon, or a compound thereof.
- 319 This subclass is indented under subclass 317. Processes which include the step of reacting an acid with phosphate rock.
- 320 This subclass is indented under subclass 319. Processes in which the acid includes sulfuric acid ( $\text{H}_2\text{SO}_4$ ).
- 321.1 **Purification or recovery:**  
This subclass is indented under subclass 317. Process wherein the product is separated from impurities or undesired foreign matter.
- 321.2 **Organic solvent extraction:**  
This subclass is indented under subclass 321.1. Process wherein separation is by dissolution in an organic liquid.
- (1) Note. Dissolution may be of product or impurity.
- 322 This subclass is indented under subclass 299. Products or processes wherein the product is elemental phosphorus.
- (1) Note. Changing yellow phosphorus to red phosphorus involves a chemical reaction since the water of hydration is changed, see (9) Note in the class definition.
- 323 This subclass is indented under subclass 322. Processes which include the step of reacting a material which contains a phosphate ( $\text{PO}_4^{3-}$ ) radical, e.g., phosphate rock, etc.
- 324 This subclass is indented under the class definition. Products and processes wherein the product is silicon or a compound thereof.
- (1) Note. Silicon and silicon dioxide are arbitrarily considered to be glass. A process of chemically manufacturing silicon or silicon dioxide combined with significant shaping or heat treatment will be found in either Class 438, Semiconductor Device Manufacturing: Process, or Class 65, Glass Manufacturing.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing silicon, oxygen, and metals.
- 325 This subclass is indented under subclass 324. Products or processes wherein the product contains oxygen.
- 326 This subclass is indented under subclass 325. Products or processes wherein the product also contains at least one metal.
- 327.1 **Aluminum containing:**  
This subclass is indented under subclass 326. Products or processes in which the metal is aluminum.
- 327.2 **Mullite:**  
This subclass is indented under subclass 327.1. Products and processes in which the product is mullite (i.e.,  $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ ).
- 328.1 **Aluminosilicate:**  
This subclass is indented under subclass 327.1. Product or processes in which the product is an aluminum silicate in combination with a metal oxide.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
118, for processes of treating mixtures to obtain an aluminosilicate.
- 328.2 Crystalline:**  
This subclass is indented under subclass 328.1. Products and processes in which the products have geometrically arranged plane faces or surfaces and a symmetrical internal structure (e.g., pillared or phyllosilicates).
- (1) Note. Crystalline aluminosilicates, such as sorbents, are to be considered products for Class 423, unless mixed with an additive whose function is not solely to perfect the product. See (6) Note to the definition of subclass 265.
- (2) Note. Three dimension crystalline structural products that are zeolites are excluded from this subclass. See (2) Note to the definition of subclass 700.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
700, for products and processes wherein the product is a zeolite.
- SEE OR SEARCH CLASS:  
501, Compositions: Ceramic, subclasses 141+ for ceramic compositions and processes for producing such.
- 328.3 Mica:**  
This subclass is indented under subclass 328.2. Products and processes in which the geometrical arrangement has a lamina structure which can be split into thin sheets (e.g., biotite, muscovite, phlogopite, zinnwaldite).
- 329.1 X-ray diffraction pattern:**  
This subclass is indented under subclass 328.1. Products wherein the aluminosilicate structure is identified by a diffraction grating produced by an X-ray passing through it.
- (1) Note. Original patents in this subclass require that an X-ray diffraction pattern be referenced in the claim.
- 330.1 Gelling or precipitation:**  
This subclass is indented under subclass 328.1. Processes which include either forming a gel or causing a substance to come out of solution.
- 331** This subclass is indented under subclass 326. Products or processes in which the product contains magnesium, calcium, strontium or barium (i.e., the alkaline earth metals).
- 332** This subclass is indented under subclass 326. Products or processes in which the product contains lithium, sodium, potassium, rubidium or cesium (i.e. an alkali metal).
- 333** This subclass is indented under subclass 332. Processes which include the step of causing a substance to become insoluble and come out of solution or to become a jelly like mass in a solution, the solution being that of the silicate of an alkali metal.
- 334** This subclass is indented under subclass 332. Processes which include the step of reacting the alkali metal with silica (silicon dioxide) while heating.
- 335** This subclass is indented under subclass 325. Products or processes in which the product is silicon dioxide (Si O<sub>2</sub>).
- 336** This subclass is indented under subclass 335. Processes which include the step of hydrolyzing a silicon compound while in the vapor phase.
- 337** This subclass is indented under subclass 335. Processes which include the step of causing (1) a volatile silicon compound to unite with oxygen or (2) an increase of electronegative elements or radicals in a volatile silicon compound.
- (1) Note. Combustion is a form of oxidation and is included under this definition.
- 338** This subclass is indented under subclass 335. Processes which include the step of gellation or forming a jelly like mass.

- 339** This subclass is indented under subclass 335. Processes which include the step of causing a substance to come out of solution or become insolubilized.
- 340** This subclass is indented under subclass 335. Processes which include the step of purifying silicon dioxide.
- 341** This subclass is indented under subclass 324. Products or processes wherein the product contains a halogen.
- 342** This subclass is indented under subclass 341. Products or processes in which the product is similar to a halogenated hydrocarbon in which a tetravalent silicon replaces the carbon atom; (silane is  $\text{SiH}_4$ , trichlorosilane is  $\text{SiHCl}_3$ ).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
347, for the binary silane compound.
- 343** This subclass is indented under subclass 341. Processes which include the step of causing a normally solid substance to pass into a gas or a vapor; see Glossary.
- 344** This subclass is indented under subclass 324. Products or processes wherein the product is a compound containing silicon and only one additional element.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
335+, for binary silicon and oxygen containing compounds.  
341+, for halogen containing compounds which may be binary.
- 345** This subclass is indented under subclass 344. Products or processes wherein the additional element is carbon.
- 346** This subclass is indented under subclass 345. Processes which include the step of reacting carbon or a carbon containing compound with a silicon containing compound that is in the vapor phase.
- 347** This subclass is indented under subclass 344. Products or processes in which the additional element is hydrogen.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
342, for halogen derivatives of the binary silanes.
- 348** This subclass is indented under subclass 324. Products or processes wherein the product is elemental silicon.
- SEE OR SEARCH CLASS:  
117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, especially subclasses 54+ for liquid phase epitaxial growth processes and subclasses 84+ for vapor phase growth processes.  
438, Semiconductor Device Manufacturing, particularly subclasses 478+ for methods of depositing semiconductive silicon which is to function as an active region of a barrier layer device.
- 349** This subclass is indented under subclass 348. Processes wherein the starting materials include a silicon containing compound.
- 350** This subclass is indented under subclass 349. Processes which include the use of a reducing element, compound or composition to release the silicon from the compound.
- (1) Note. Heat is not a reducing "substance" for the purposes of this subclass. If only heat is used to reduce the silicon containing compound the patent is classified in subclass 349 above.
- 351** This subclass is indented under the class definition. Products or processes in which the product is nitrogen or a compound thereof, limited as follows: where the compound is an ammonium ( $\text{NH}_4^+$ ) salt, the anion must contain a nitrogen atom.
- (1) Note. Ammonium hydroxide ( $\text{NH}_4\text{OH}$ ) is included under this definition.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
217, for the process of separating or obtaining nitrogen from atmospheric

air where it is the intent to separate components of or purify the air.

**SEE OR SEARCH CLASS:**

- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing nitrogen, oxygen, halogen, and metals.
- 352** This subclass is indented under subclass 351. Products or processes wherein the product is ammonia ( $\text{NH}_3$ ), or ammonium hydroxide ( $\text{NH}_4\text{OH}$ ).
- 353** This subclass is indented under subclass 352. Processes in which the product is made from the nitride of a metal or of silicon.
- (1) Note. Where a metal or metal compound is contacted alternately with free nitrogen and free hydrogen and ammonia is produced, it is assumed that the nitrogen contact produces a nitride which is converted to ammonia in the later contact with hydrogen, and classification in this subclass is proper.
- 354** This subclass is indented under subclass 352. Processes in which an inorganic compound containing carbon and nitrogen is also made.
- (1) Note. The inorganic compound is usually a cyanide or cyanamide.
- (2) Note. The manufacture of the inorganic compound may precede or be simultaneous with the manufacture of the ammonia.
- 355** This subclass is indented under subclass 352. Processes which include the step of hydrolyzing an inorganic compound containing carbon and nitrogen.
- (1) Note. The inorganic compound is usually a cyanide or cyanamide.
- (2) Note. The hydrolyzing agent is usually steam.
- 356** This subclass is indented under subclass 352. Processes in which the product is made from a compound containing the ammonium ( $\text{NH}_4^+$ ) radical.
- (1) Note. The processes usually involve contact of the compound with steam.
- (2) Note. The nitrogen in inorganic salts such as  $\text{NH}_4\text{Cl}$  and  $(\text{NH}_4)_2\text{SO}_4$  is often referred to as "fixed nitrogen" in these patents.
- 357** This subclass is indented under subclass 356. Processes in which a compound containing the element calcium ( $\text{Ca}^{++}$ ) is used.
- 358** This subclass is indented under subclass 352. Processes in which the product is made from a substance which contains nitrogen and is of organic structure.
- (1) Note. The organic material is frequently a waste product or of undetermined constitution.
- (2) Note. The reaction often is a steam hydrolysis.
- (3) Note. See subclass 226 (1) Note for structural requirement of an organic material.
- SEE OR SEARCH THIS CLASS, SUBCLASS:**  
550, for processes wherein ammonia from waste gases is recovered as ammonium sulfate.
- 359** This subclass is indented under subclass 352. Processes in which the product is made from elemental hydrogen and nitrogen.
- 360** This subclass is indented under subclass 359. Processes including the step of exchanging heat values between a catalyst used in the process and the mixture of gases either prior to, or subsequent to, the reaction.
- 361** This subclass is indented under subclass 359. Processes which include the use of more than a single catalyst bed, or in which different por-



tions of a single catalyst bed are subjected to different processing conditions, e.g., temperature, pressure, composition of reactant mixture, etc.

**362** This subclass is indented under subclass 359. Processes in which a catalyst comprising a metal is utilized.

**363** This subclass is indented under subclass 362. Processes in which the metal is lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium or barium.

**364** This subclass is indented under subclass 351. Products or processes in which the product also comprises carbon.

**365** This subclass is indented under subclass 364. Products or processes in which the product also contains oxygen.

**366** This subclass is indented under subclass 364. Products or processes wherein the product also contains sulfur.

**367** This subclass is indented under subclass 364. Products or processes wherein the product also contains iron.

**368** This subclass is indented under subclass 364. Products or processes in which the carbon is combined with nitrogen as the cyanamide radical (CN<sub>2</sub>.1).

(1) Note. In this subclass are found salts of cyanamide. For hydrogen cyanamide see search note below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

369, for processes of making hydrogen cyanamide or for chemically separating or purifying the product.

371, for processes producing carbonitrides having formulas wherein carbon and nitrogen atoms are present in the ratio of one carbon to two nitrogens, but are not clearly cyanamide compounds.

SEE OR SEARCH CLASS:

260, Chemistry of Carbon Compounds, for cyanamide polymers such as dicyan-diamide and melamine.

**369** This subclass is indented under subclass 368. Products or processes wherein the compound contains hydrogen and is usually named cyanamide, but may also be called cyanogenamide or carbodiimide, and has the formula HN:CNH (H<sub>2</sub>CH<sub>2</sub>) or N:CNH<sub>2</sub> (H<sub>2</sub>NCH).

SEE OR SEARCH THIS CLASS, SUBCLASS:

368, for processes of separating, purifying or manufacturing the cyanamide salt or a metal or the ammonium radical.

**370** This subclass is indented under subclass 368. Processes which include the step of using a carbide as a reactant.

**371** This subclass is indented under subclass 364. Products or processes in which the product consists of only one element in addition to the carbon and nitrogen.

(1) Note. The ammonium (NH<sub>4</sub><sup>+</sup>) radical is considered to be a single element, see (1) Note to the class definition.

**372** This subclass is indented under subclass 371. Products or processes in which the product is hydrogen cyanide (HCN), which may also be designated as hydrocyanic acid, prussic acid, or formonitrile.

**373** This subclass is indented under subclass 372. Processes including the use of formamide (HCONH<sub>2</sub>) or of a compound containing the formamide (HCONH<sup>•</sup>) radical or of a compound containing the formate (HCOO<sup>•</sup>) radical.

(1) Note. The formate is usually in the form of the ammonium salt.

**374** This subclass is indented under subclass 372. Processes which include the use of free nitrogen or nitric oxide in a reaction.

- (1) Note. The presence of air in the reaction zone is not sufficient to classify a patent herein, unless clearly disclosed as the source of nitrogen.
- 375** This subclass is indented under subclass 372. Processes including the use of ammonia in a reaction.
- 376** This subclass is indented under subclass 375. Processes wherein a catalyst is used.
- 377** This subclass is indented under subclass 372. Processes including the use of a cyanide of a metal in a reaction.
- (1) Note. Solutions and solids which contain undefined "cyanides" and are acidified, thus producing the product, are presumed to be metal cyanides for this subclass.
- SEE OR SEARCH CLASS:  
422, Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing, subclass 36 for process of sterilizing or disinfecting using cyanide.
- 378** This subclass is indented under subclass 371. Processes which include the use of cyanamide or a cyanamide salt in a reaction.
- 379** This subclass is indented under subclass 371. Processes which include the use of hydrogen cyanide (HCH) in a reaction.
- 380** This subclass is indented under subclass 371. Processes including the use of elemental or free nitrogen in a reaction.
- (1) Note. The presence of atmospheric air in the reaction is not sufficient to classify a patent in this subclass, unless clearly disclosed as the source of nitrogen.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
374, for a process in which free or elemental nitrogen is used in the manufacture of hydrogen cyanide.
- 381** This subclass is indented under subclass 380. Processes which include the use of a catalyst.
- 382** This subclass is indented under subclass 380. Processes which also include the use of carbon in a reaction and which is further disclosed as originating from a particular source, e.g., charcoal, a carbide, oil, etc.
- (1) Note. Where the reactant is described merely as "carbon" or "carbonaceous", this is not sufficient for classification herein.
- 383** This subclass is indented under subclass 364. Products or processes in which the product also contains a halogen.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
371+, for products and processes for making such products in which the halogen is one of three elements in a ternary compound.
- 384** This subclass is indented under subclass 364. Processes in which only nitrogen and carbon form the product, e.g., cyanogen (C<sub>2</sub>N<sub>2</sub>).
- 385** This subclass is indented under subclass 351. Products or processes in which the product also contains oxygen.
- 386** This subclass is indented under subclass 385. Products or processes wherein the product also contains a halogen.
- 387** This subclass is indented under subclass 585. Products or processes wherein the product also contains hydrogen.
- 388** This subclass is indented under subclass 387. Products or processes in which the product also contains sulfur.
- 389** This subclass is indented under subclass 388. Products or processes wherein the product is sulfamic acid or aminosulfonic acid, having one of the following formulas: HSO<sub>3</sub>HN<sub>2</sub>, NH<sub>2</sub>SO<sub>3</sub>H or H<sub>2</sub>NSO<sub>3</sub>H.

- 390.1 Nitric acid:**  
This subclass is indented under subclass 387. Products and processes in which the product is nitric acid; i.e.,  $\text{HNO}_3$ .
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
400, for processes for the production of nitrogen oxides, per se.
- 391** This subclass is indented under subclass 390.1. Processes which include the step of contacting a salt and an acid for a reaction.
- 392** This subclass is indented under subclass 390.1. Processes which include the use of ammonia in a reaction.
- 393** This subclass is indented under subclass 390.1. Processes in which an oxide of nitrogen is used as a reactant.
- (1) Note. For this and the indented subclass the “reactant” may or may not be the starting material. The “reactant” may be used to make an intermediate product which is then used to make the desired product or the “reactant” may be used to directly make the desired product.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
392, for processes in which ammonia is oxidized to form a nitrogen oxide as an intermediate product.
- 394** This subclass is indented under subclass 393. Processes in which the nitrogen oxide is nitrogen peroxide, ( $\text{NO}_2$  or  $\text{N}_2\text{O}_4$ ).
- 394.2 Purification or recovery:**  
This subclass is indented under subclass 390.1. Processes wherein the nitric acid is separated from impurities or undesired foreign matter.
- 395** This subclass is indented under subclass 385. Products or processes wherein the product contains the nitrate radical ( $\text{NO}_3^-$ ).
- (1) Note. Included under this definition are double salts of the nitrate radical, such as  $\text{NaNO}_3$ .  $\text{CaSO}_4$ .
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
396, for processes wherein ammonium nitrate is made by reacting a nitrate.
- 396** This subclass is indented under subclass 395. Products or processes wherein the product contains the ammonium ( $\text{NH}_4^+$ ) radical.
- 397** This subclass is indented under subclass 395. Processes which include the use of a nitrate compound containing a metal or the ammonium ( $\text{NH}_4^+$ ) ion as a reactant.
- 398** This subclass is indented under subclass 395. Processes in which a compound containing a halogen is used as a reactant.
- 399** This subclass is indented under subclass 398. Processes which also include the use of nitric acid ( $\text{HNO}_3$ ) as a reactant.
- 400** This subclass is indented under subclass 385. Products or processes wherein the product contains only nitrogen and oxygen.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
390.1, for processes for the production of nitric acid, which may include production of nitrogen oxides.
- 401** This subclass is indented under subclass 400. Processes which include the use of nitrosyl chloride ( $\text{NOCl}$ ) as a reactant.
- 402** This subclass is indented under subclass 400. Processes in which a catalyst is used.
- 403** This subclass is indented under subclass 402. Processes which include the use of ammonia as a reactant.
- 404** This subclass is indented under subclass 403. Processes wherein the catalyst contains the oxide of a metal.
- 405** This subclass is indented under subclass 400. Processes wherein the product is nitric oxide ( $\text{NO}$ ).

- 406** This subclass is indented under subclass 351. Products or processes wherein the product includes nitrogen and only one additional element.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
290, for binary compounds containing nitrogen and boron and 400+ for binary compounds containing nitrogen and oxygen.
- 407** This subclass is indented under subclass 406. Products or processes in which the product is hydrazine ( $\text{H}_2\text{NNH}_2$ ) or hydrazine hydrate ( $\text{H}_2\text{NNH}_2 \cdot \text{H}_2\text{O}$ ).
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
388, for hydrazine sulfate ( $\text{NH}_2\text{NH}_2 \cdot \text{H}_2\text{SO}_4$ ).
- 408** This subclass is indented under subclass 407. Processes which include the use of a reactant containing sulfur or a halogen.
- 409** This subclass is indented under subclass 406. Products or processes in which the additional element is either a metal or the ammonium ( $\text{NH}_4^+$ ) radical.
- (1) Note. The ammonium ( $\text{NH}_4^+$ ) radical is considered to be a single element, see (1) Note to the class definition.
- SEE OR SEARCH CLASS:  
148, Metal Treatment, subclass 16.6 and 317+ for processes of making case hardened (nitrided) metals and the corresponding products, the intention being to form such case hardened metal, not to form a definite compound for recovery thereof, see reference to Class 148 in Line and Search Note Section of the Class Definition (423).
- 410** This subclass is indented under subclass 409. Products or processes wherein the product includes the azide radical ( $-\text{N}_3$ ), with the metal or ammonium.
- 411** This subclass is indented under subclass 409. Products or processes wherein the metal is titanium or zirconium.
- 412** This subclass is indented under subclass 409. Products or processes wherein the metal is aluminum.
- 413** This subclass is indented under subclass 351. Products or processes in which the product contains hydrogen.
- (1) Note. Examples of compounds found in this subclass are: Amides ( $-\text{NH}_2$ ) and imides ( $-\text{NH}$ ).
- 414** This subclass is indented under the class definition. Products or processes in which the product is carbon or a compound thereof.
- SEE OR SEARCH CLASS:  
75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 236+ for consolidated metal power compositions containing a carbide.  
260, Chemistry of Carbon Compounds, for organic compounds and processes of making such compounds, meeting the structural requirements set out in the class definition thereof; see also (1) Note in subclass 226 of this class 423.  
419, Power Metallurgy Processes, subclasses 14+ for processes of making articles from particulate material including a metal and a carbide compound comprising pressure and heat.  
585, Chemistry of Hydrocarbon, appropriate subclasses for compounds containing carbon and hydrogen only, methods for their synthesis and purification, and certain compositions containing hydrocarbons.  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing carbon, oxygen, sulfur, and metals.

**415.1 Oxygen containing:**

This subclass is indented under subclass 414. Products or processes in which the product also contains oxygen.

**415.2 Percarbonate compound:**

This subclass is indented under subclass 415.1. Products or processes wherein the compound has a percarbonate grouping; i.e., a  $(\text{CO}_4^{2-})$  radical.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

281, for processes of making perborates.  
513, for processes of making persulfates.  
584, for products and processes where the product is a peroxide.

SEE OR SEARCH CLASS:

252, Compositions, subclasses 181+ for bleaching agents.

**416** This subclass is indented under subclass 415.1. Products or processes wherein the product contains the carbonyl group (CO) such as in iron penta carbonyl,  $\text{Fe}(\text{CO})_5$ , or carbonyl sulfide, COS.

SEE OR SEARCH CLASS:

260, Chemistry of Carbon Compounds, subclass 544 for carbonyl halide compounds or processes of making such compound.

**417** This subclass is indented under subclass 416. Products or processes wherein the product contains a metal in addition to the carbonyl group.

**418** This subclass is indented under subclass 417. Processes wherein at least one reactant is an organic chemical compound.

(1) Note. See (1) Note in subclass 226 for structural requirements of an organic compound.

**418.2 Carbon monoxide:**

This subclass is indented under subclass 415.1. Products or processes wherein the product is carbon monoxide; i.e., CO.

**419.1 Carbonate or bicarbonate:**

This subclass is indented under subclass 415.1. Products or processes wherein the product contains a carbonate ( $\text{CO}_3^{2-}$ ) or bicarbonate ( $\text{HCO}_3^-$ ) radical.

(1) Note. A percarbonate may also be expressed as a carbonate in addition to a peroxide (e.g.,  $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}_2$ ); such compounds are assumed to have a percarbonate ( $\text{CO}_4^{2-}$ ) radical.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

105, for processes of treating mixtures to obtain a zinc (Zn), cadmium (Cd), or mercury (Hg) carbonate including (a) forming an insoluble substance in a liquid and (b) chemically forming a compound having the carbonate ( $\text{CO}_3^{2-}$ ) radical.

415.2, for products and processes wherein a compound has a percarbonate grouping.

**420** This subclass is indented under subclass 419.1. Products or processes wherein the carbonate contains the ammonium ( $\text{NH}_4^+$ ) radical.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

237, for a process of preparing ammonium carbonate from ammonia in waste gas, the carbonate being recovered as a by-product, where the main intent is to purify the gas.

**420.2 Plural metal containing:**

This subclass is indented under subclass 419.1. Products or processes wherein the carbonate product contains more than a single metal.

(1) Note. The plural metal of the carbonate compound may be multiple occurrences of the same metallic element in the compound.

**421** This subclass is indented under subclass 419.1. Products or processes wherein the carbonate contains an alkali metal (lithium, sodium, potassium, rubidium or cesium).

- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 186, for processes of treating mixtures with a carbon containing compound to form an alkali metal carbonate or bicarbonate, including the step of forming an insoluble substance in a liquid.
- 422** This subclass is indented under subclass 421. Products or processes in which the radical contains hydrogen and is the bicarbonate ( $\text{HCO}_3^-$ ) radical.
- 423** This subclass is indented under subclass 422. Processes which include the step of carbonating a solution of ammonia and a salt.
- 424** This subclass is indented under subclass 422. Processes which include the step of reacting a compound that contains a halogen.
- 425** This subclass is indented under subclass 422. Products or processes in which the product is a sesquicarbonate, i.e., a combination of a simple normal carbonate (e.g.,  $\text{Na}_2\text{CO}_3$ ) and simple bicarbonate (e.g.,  $\text{NaHCO}_3$ ).
- 426** This subclass is indented under subclass 421. Processes which include the step of compacting or compressing soda ash (crude sodium carbonate).
- 427** This subclass is indented under subclass 421. Processes which include the step of reacting a bicarbonate ( $\text{HCO}_3^-$ ).
- 428** This subclass is indented under subclass 421. Processes which include the step of reacting a compound containing sulfur.
- 429** This subclass is indented under subclass 421. Processes which include the step of reacting a compound containing a halogen.
- 430** This subclass is indented under subclass 419.1. Products or processes wherein the carbonate contains magnesium, calcium, strontium or barium, i.e., the alkaline earth metals.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 165, for processes of treating mixtures to obtain alkaline earth metal carbonates.
- 431** This subclass is indented under subclass 430. Processes which include the step of reacting a compound that contains sulfur or a halogen.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 165, for processes of treating mixtures to obtain an alkaline earth metal carbonate, including the steps of (1) forming an insoluble substance in a liquid, and (2) chemically forming a carbonate having the  $\text{CO}_3^{2-}$  radical.
- 432** This subclass is indented under subclass 430. Processes which include the step of reacting an oxide or a hydroxide that contains the metal of the carbonate product.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 165, for processes of treating mixtures to obtain an alkaline earth metal carbonate including the steps of (1) forming an insoluble substance in a liquid, and (2) chemically forming a carbonate having the  $\text{CO}_3^{2-}$  radical.
- 433** This subclass is indented under subclass 419.1. Products or processes wherein the carbonate contains lead.
- 434** This subclass is indented under subclass 433. Processes which include the step of reacting a compound that contains sulfur or a halogen.
- 435** This subclass is indented under subclass 433. Processes which include the step of reacting lead acetate or acetic acid.
- 436** This subclass is indented under subclass 435. Processes which also include the step of reacting elemental lead.

**437.1 Carbon dioxide or carbonic acid:**

This subclass is indented under subclass 415.1. Products or processes wherein the product is carbon dioxide (CO<sub>2</sub>) or a solution thereof in water.

**437.2 From carbon monoxide:**

This subclass is indented under subclass 437.1. Processes in which the product is made from carbon monoxide (CO).

**438** This subclass is indented under subclass 437.1. Processes in which the product is made from a compound containing the carbonate (CO<sub>3</sub><sup>2-</sup>) or the bicarbonate (HCO<sub>3</sub><sup>-</sup>) radical.

**439** This subclass is indented under subclass 414. Products or processes wherein the product contains carbon and only one other element.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

345, for binary compounds which contain only carbon and silicon.

415.1, for carbon monoxide.

SEE OR SEARCH CLASS:

148, Metal Treatment, subclass 16.5 and 316+ for processes for making case hardened (carbided) metals and the corresponding products, the intention being to form such case hardened metal, not to form a definite compound for recovery; see reference to Class 148 in line and Search Note Section of the Class Definition.

**440** This subclass is indented under subclass 439. Products or processes wherein the other element is chromium, molybdenum, tungsten, vanadium, niobium, tantalum, titanium, zirconium or hafnium, known as the refractory metals.

**441** This subclass is indented under subclass 439. Products or processes wherein the other element is calcium.

**442** This subclass is indented under subclass 441. Processes which include the step of reacting carbon with an inorganic compound containing calcium.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

174, for processes of making calcium carbide from an impure calcium carbonate such as limestone.

**443** This subclass is indented under subclass 439. Products or processes wherein the binary compound is carbon disulfide.

**444** This subclass is indented under subclass 443. Processes which include the step of reacting elemental carbon.

**445** This subclass is indented under subclass 414. Products or processes wherein the product is free carbon in substantially pure form.

(1) Note. See the note in the Class 264 class definition II. A. (10) for the line between Class 264 and Class 423 subclasses 445+ concerning combined processes of molding and carbonizing.

SEE OR SEARCH CLASS:

201, Distillation: Processes, Thermolytic, appropriate subclasses, for a process of making coke.

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 174+ for compositions of and methods of making inorganic carbon containing catalyst or precursor therefor, subclasses 416+ for compositions of and methods of making solid sorbent compositions including elemental carbon.

516, Colloid Systems and Wetting Agents; Subcombinations Thereof; Processes of Making, Stabilizing, Breaking, or Inhibiting, subclass 32 for colloid systems of colloid-sized solid or semi-solid material which is primarily Carbon (such as graphite or diamond) dispersed in primarily organic continuous liquid phase, subclasses 38+ for colloid systems of colloid-sized bituminous, coal, or Carbon phase dispersed in aqueous continuous liquid phase, cross-reference art collection 901 for collection of art under the Class definition related to colloid systems of substantially pure elemental

Carbon (such as graphite, diamond, Carbon black, lamp black, Fullerenes); or agents for such systems or making or stabilizing such systems or agents; in each instance, when generically claimed or when there is no hierarchically superior provision in the USPC for the specifically claimed art.

- 446** This subclass is indented under subclass 445. Products or processes wherein the product is carbon crystallized in the isometric form, usually in octahedral shape.

**SEE OR SEARCH CLASS:**

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, subclass 79 for processes for growing therein-defined single-crystal of diamond and subclass 929 for the art collection of carbon single-crystal references. Class 423, subclass 446, is a mandatory search and cross-reference for patents directed to forming a free-standing single-crystal diamond even though properly placed in Class 117 as an original.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclass 84 for the process of molding with a high pressure generated by an explosive force.
- 425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 1 for apparatus for molding with a high pressure generated by an explosive force; subclass 77 for making diamonds by applying ultra high pressure.
- 447.1** This subclass is indented under subclass 445. Products and processes ... wherein the product is substantially pure carbon in the form of a slender threadlike structure (fiber) a woven, knitted or felled sheet material (fabric) or a woven fabric or cloth (textile).
- SEE OR SEARCH CLASS:**
- 8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, subclasses 115.51+ for processes and compositions for treating textiles and fibers to effect a chemical modification thereof, where the resulting product is other than an inorganic compound or element (e.g., carbon) as provided for in this class 423.
- 428, Stock Material or Miscellaneous Articles, subclass 367 for a carbon fiber structurally defined as provided for in the Class 428 definitions.
- 447.2** This subclass is indented under subclass 447.1. Products .
- (1) Note. In order to be placed in this subclass as an original, a patent must contain a claim to an elemental carbon fiber, fabric or textile.
- 447.3** This subclass is indented under subclass 447.1. Processes wherein all the carbon forming reactant(s) are in the gaseous phase.
- 447.4** This subclass is indented under subclass 447.1. Processes wherein prior to a reaction to convert a fiber, fabric or textile article to carbon, the article is treated with a substance other than gaseous oxygen which substance either (a) chemically reacts with the article or (b) is retained in the article at least until the commencement of a reaction to convert the article to carbon.
- 447.5** This subclass is indented under subclass 447.4. Processes wherein the treating substance is a metal, a metal containing compound or a phosphorus containing compound.
- 447.6** This subclass is indented under subclass 447.1. Processes including a step of reaction with gaseous oxygen.
- (1) Note. Heating in air is considered to be reaction with gaseous oxygen only when it is positively disclosed that such a reaction takes place.



**447.7** This subclass is indented under subclass 447.1. Processes including a step of reaction in a specifically recited atmosphere other than vacuum or air.

**447.8** This subclass is indented under subclass 447.1. Processes wherein a carbonizing reaction is carried out by (1) varying the temperature over a given time span or by (2) heating to two or more distinct temperatures.

(1) Note. Heating to cure binder or dry is not considered a carbonizing reaction without positive disclosure that carbonizing occurs under those conditions.

(2) Note. Heating a temperature to cause a change in crystalline form of the carbon (e.g., graphitizing) is considered a step of carbonizing for this subclass.

**447.9** This subclass is indented under subclass 447.1. Processes wherein the material carbonized is natural cellulose or its derivatives (e.g., esters, ether, regenerated cellulose, etc.).

**448** This subclass is indented under subclass 445. Products or processes wherein the product is graphite, which is the crystalline allotropic form of carbon, characterized by a hexagonal arrangement of the atoms.

SEE OR SEARCH THIS CLASS, SUBCLASS:

447, for a fiber, textile or fabric which is made of graphite.

**449.1 Carbon black (e.g., lampblack):**  
This subclass is indented under subclass 445. Products or processes wherein the product is a finely divided carbon particulate.

SEE OR SEARCH CLASS:

264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclass 84 for processes of molding with high pressure generated by an explosive force.

425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 77 for apparatus making diamonds by applying ultra high pressure.

**449.2 Treating carbon black:**

This subclass is indented under subclass 449.1. Processes wherein carbon black is treated to change its characteristics.

**449.3 Treating with acid, or gas which forms an acid in water:**

This subclass is indented under subclass 449.2. Processes wherein the carbon black material is treated with a compound that is an acid or with a gas that in an aqueous state would form an acid (e.g., H<sub>2</sub>S).

**449.4 Halogen or compound thereof:**

This subclass is indented under subclass 449.2. Processes wherein the acid or the gas includes a halogen group element (e.g., HCl).

**449.5 Gaseous oxygen containing compound:**

This subclass is indented under subclass 449.2. Processes wherein the treatment is with a gaseous compound including oxygen (e.g., CO).

**449.6 Utilizing synthetic polymer as reactant:**

This subclass is indented under subclass 449.1. Processes wherein a compound that is a synthetic polymer (e.g., polyacrylonitrile) is reacted or decomposed to form the product.

**449.7 Tire:**

This subclass is indented under subclass 449.6. Processes wherein the polymer is obtained from tires or parts thereof.

(1) Note. Included in this subclass are polymeric material from scrap tires composed of compounds that include those produced by vulcanization of natural or synthetic rubber.

**449.8 Solid material in feed:**

This subclass is indented under subclass 449.1. Processes which include feeding stock material that is in a solid-state, either homogeneous or heterogeneous (e.g., wood or coke).

**449.9 Liquid feed only:**

This subclass is indented under subclass 449.1. Processes wherein initial feed stock is in a liquid state only.

- 450** This subclass is indented under subclass 449.1. Processes wherein the carbon is made from the direct pyrolysis, cracking or decomposition of a compound containing only carbon and hydrogen (i.e., hydrocarbon) which is normally in the liquid or gaseous state.
- (1) Note. Any "oil" or any "gas" (e.g., natural) is considered to qualify under this definition of hydrocarbon unless it is clear from the disclosure that an element other than carbon and hydrogen is present in the gas or oil. However, impurities in the fluid are disregarded if they are not the source for the carbon.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
449, for a process which uses a halogen containing compound, e.g.,  $\text{CHCl}_3$ , as the feed stock for carbon black.
- 451** This subclass is indented under subclass 450. Processes wherein the carbon is formed from the hydrocarbon by rapid and discontinuous oxidation such as in an explosive reaction.
- 452** This subclass is indented under subclass 450. Processes wherein the carbon is deposited from a flame by causing the flame to directly contact a relatively cool surface.
- 453** This subclass is indented under subclass 450. Processes in which the decomposition takes place on contact between the hydrocarbon and (1) catalytic material or (2) a solid surface heated to a temperature at which the pyrolysis can occur.
- 454** This subclass is indented under subclass 453. Processes in which the contact is with a heated solid surface comprising particulate solids or the inner surface or firebrick of the zone in which the decomposition takes place.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
453, for a process of making carbon by contact of a fluid hydrocarbon with a liquid catalyst or a bed of unheated particulate solids.
- 455** This subclass is indented under subclass 450. Processes in which the speed of entry into the reaction zone of any feed material associated with the process is specifically stated.
- (2) Note. The term "feed material" under this definition is not limited to the hydrocarbon being decomposed to result in the carbon; it also includes atomizing, heating, combustion or carrier gas, fuel, heat exchange medium, etc.
- 456** This subclass is indented under subclass 450. Processes in which the angle of entry into the reaction zone of any feed material associated with the process is specifically stated.
- (1) Note. The term "feed material" under this definition is not limited to the hydrocarbon being decomposed; it also includes any material associated in any manner with the process, e.g., atomizing, heating, combustion, or carrier gas, fuel, etc.
- 457** This subclass is indented under subclass 456. Processes in which at least one feed material enters the reaction zone in a direction which, if extended would intersect the longitudinal axis.
- 458** This subclass is indented under subclass 450. Processes in which the hydrocarbon feed consists of a fluid which is normally in the gas or vapor state.
- (1) Note. A normal gas or vapor is considered to be a compound having between 1 and 4 carbons only.
- (2) Note. Excluded under this definition is a process in which a liquid had been vaporized before entering the reaction zone. The initial starting material must be a normal gas or vapor for this subclass; if liquid, classification is in subclass 450.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
450, for a process in which the initial feed-stock comprises a liquid, a mixture of gas and liquid or either gas or liquid, claimed generically as a fluid.

- 459** Processes under 449.1 wherein the carbon is made from carbon monoxide.
- 460** This subclass is indented under subclass 445. Processes wherein carbon in the elemental state is treated to change its characteristics.
- 461** This subclass is indented under subclass 445. Processes wherein the carbon is separated from impurities.
- 462** This subclass is indented under the class definition. Products or processes in which the product is a nonmetallic element of Group VII A of the periodic system having atomic numbers 9, 17, 35, or 53, or a compound thereof.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
249, for astatine (Atomic No. 85), which is the radioactive member of the halogens, and compounds thereof.
- SEE OR SEARCH CLASS:  
588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing halogens, oxygen, sulfur, and metals.
- 463** This subclass is indented under subclass 462. Products or processes in which the product is a compound, which contains either (1) two or more diverse and distinct metal elements or (2) a metal and the ammonium ( $\text{NH}_4^+$ ) radical.
- 464** This subclass is indented under subclass 463. Products and processes in which the halogen is fluorine.
- 465** This subclass is indented under subclass 464. Products or processes in which the product contains aluminum.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
116, for processes of treating mixtures to obtain a plural metal and halogen containing compound, wherein one of the metals is aluminum.
- 466** This subclass is indented under subclass 462. Products or processes wherein the products includes two or more different halogens.
- 467** This subclass is indented under subclass 462. Products or processes wherein the product contains sulfur.
- 468** This subclass is indented under subclass 467. Products or processes wherein the product is a ternary compound and contains only oxygen in addition to the sulfur and halogen.
- 469** This subclass is indented under subclass 467. Products or processes wherein the product is a binary compound and contains only sulfur and a halogen.
- 470** This subclass is indented under subclass 462. Products or processes wherein the product consists of the ammonium ( $\text{NH}_4^+$ ) radical and a halogen.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
462, for ammonium bifluoride ( $\text{NH}_4\text{F}\cdot\text{HF}$ ).
- 471** This subclass is indented under subclass 470. Products or processes in which the ammonium halide is obtained by separation or purification from a mixture (usually waste material).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
237, for a process of preparing an ammonium halide from the ammonia in waste gas where the main intent is to purify the gas, the halide being recovered as a by-product and the recovery being of secondary importance.
- 472** This subclass is indented under subclass 462. Products or processes wherein the product is a ternary compound and consists of two elements in addition to the halogen.
- (1) Note. For purposes of this and indented subclasses, the ammonium radical is considered to be a single entity (element) and is classified as a ternary compound when combined with two other elements, but not as a hydrogen containing ternary

- compound; see also (1) Note in class definition.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 116, for processes of treating mixtures to obtain a ternary compound wherein two of the elements are metals and the third is a halogen, one of the metals being beryllium or a Group III A element.
- 473** This subclass is indented under subclass 472. Products or processes which consist of oxygen and a halogen as the  $(XO^-)$  radical in combination with a third element.
- 474** This subclass is indented under subclass 473. Products or processes in which the compound is calcium hypochlorite  $(Ca(OCl)_2)$ .
- 475** This subclass is indented under subclass 472. Products or processes which consist of oxygen and a halogen as the  $(XO_3^-)$  radical in combination with a third element.
- 476** This subclass is indented under subclass 472. Products or processes which consist of oxygen and a halogen as the  $(XO_4^-)$  radical in combination with a third element.
- 477** This subclass is indented under subclass 462. Products or processes wherein the compound is chlorine dioxide  $(ClO_2)$ .
- 478** This subclass is indented under subclass 477. Processes which include reacting a compound having the chlorate radical  $(ClO_3^-)$ .
- 479** This subclass is indented under subclass 478. Processes wherein the chlorate is reacted with a compound containing either nitrogen or carbon.
- 480** This subclass is indented under subclass 478. Processes wherein the chlorate is reacted with sulfur dioxide  $(SO_2)$ .
- 481** This subclass is indented under subclass 462. Products or processes wherein the compound consists of hydrogen and a halogen.
- 482** This subclass is indented under subclass 481. Processes in which include reacting an alkali metal and halogen containing salt with sulfuric acid.
- 483** This subclass is indented under subclass 481. Products or processes in which the halogen is fluorine.
- 484** This subclass is indented under subclass 483. Processes wherein the hydrogen fluoride is formed from an initial mixture containing an impurity.
- 485** This subclass is indented under subclass 484. Processes wherein the impure initial material is the mineral fluor spar (calcium fluoride, fluorite,  $CaF_2$ ).
- 486** This subclass is indented under subclass 481. Processes wherein at least one of the reactants which forms the hydrogen halide is in elemental form.
- 487** This subclass is indented under subclass 486. Processes wherein both the hydrogen and halogen are supported in the elemental form and are reacted with each other.
- 488** This subclass is indented under subclass 481. Processes which include the step of removing an impurity either from the product or from the initial mixture, e.g., removing  $H_2O$ , free halogen, etc.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 240+, for a process of removing impurities from a gaseous mixture having a halogen or a compound thereof as a constituent therein.
- 489** This subclass is indented under subclass 462. Products or processes wherein the compound contains fluorine and only one other element.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 126, for processes of treating a mixture to obtain a binary fluorine containing compound, including the step of forming an insoluble substance in a

- liquid, and 483+ for a binary compound which contains fluorine and hydrogen.
- 490** This subclass is indented under subclass 489. Products and processes in which the other element of the binary compound is lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium or barium.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
185, for treating a mixture to obtain an alkali metal and fluorine containing compound by forming an insoluble substance in a liquid.
- 491** This subclass is indented under subclass 462. Products or processes wherein the compound contains only a halogen and a metal.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
103, for processes of treating mixtures to obtain a Group II B metal halide including the steps of (1) forming an insoluble substance in a liquid and (2) chemically forming a halogen containing compound.
- 492** This subclass is indented under subclass 491. Products and processes in which the metal is of Group IV B, V B, or VI B, i.e., titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum or tungsten, commonly known as the refractory metals.
- 493** This subclass is indented under subclass 491. Products or processes in which the metal is iron, cobalt, nickel or copper.
- 494** This subclass is indented under subclass 491. Products or processes in which the metal is either germanium, tin or lead.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
90, for a process of forming salts of tin wherein the intent is to recover a tin compound by destining a mixture thereof.
- 495** This subclass is indented under subclass 491. Products or processes in which the metal is aluminum, gallium, indium, thallium or beryllium.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
126, for processes of treating a mixture to obtain a metal containing compound, wherein the metal is beryllium or a Group III A metal, including the steps of (1) forming an insoluble substance in a liquid and (2) chemically forming a halogen containing compound.  
130, for the process of recovering aluminum chloride catalysts from hydrocarbon waste materials by destroying or separating from the hydrocarbon.  
135+, for the process of recovering aluminum halides by volatilization.
- 496** This subclass is indented under subclass 495. Processes in which the compound is made by utilizing carbon or a compound thereof in a reaction.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
135+, for the process of recovering aluminum halides by volatilization wherein carbon or a carbon containing compound maybe utilized.
- 497** This subclass is indented under subclass 491. Products or processes in which the metal is magnesium, calcium, strontium or barium.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
163, for processes of treating mixtures to obtain a compound containing a halogen and an alkaline earth metal, including the steps of (1) forming an insoluble substance in a liquid and (2) chemically forming a halogen containing compound.  
490, for a binary compound consisting of fluorine and an alkali or alkaline earth metal.
- 498** This subclass is indented under subclass 497. Products or processes wherein the compound is anhydrous magnesium chloride.

**499.1 Alkali metal:**

This subclass is indented under subclass 491. Products or processes wherein the metal is an alkali metal (i.e., lithium, sodium, potassium, rubidium, or cesium).

SEE OR SEARCH THIS CLASS, SUBCLASS:

197, for treating mixtures to form an alkali metal and halogen containing compound by forming an insoluble substance in a liquid.

490, for a binary compound containing an alkali metal and fluorine.

**499.2 From carbonaceous compound:**

This subclass is indented under subclass 499.1. Products or processes wherein the alkali metal is obtained from carbon containing compound.

**499.3 Lithium chloride:**

This subclass is indented under subclass 499.1. Products and processes wherein the product is lithium chloride (i.e., LiCl).

**499.4 Sodium chloride:**

This subclass is indented under subclass 499.1. Products and processes wherein the product is sodium chloride (i.e., NaCl).

**499.5 Purification:**

This subclass is indented under subclass 499.4. Products and processes wherein purified sodium chloride is obtained.

**500** This subclass is indented under subclass 462. Products or processes wherein the product is a halogen in elemental form.

SEE OR SEARCH THIS CLASS, SUBCLASS:

249, for astatine (Atomic No. 85), which is the radioactive member of the halogen family, or a compound thereof.

**501** This subclass is indented under subclass 500. Processes which includes the step of solvent-solvent extraction or ion exchange; see Glossary.

**502** This subclass is indented under subclass 500. Processes which include the step of oxidation in the presence of a catalyst.

**503** This subclass is indented under subclass 500. Processes which include the use of a sorbent; see Glossary.

**504** This subclass is indented under subclass 500. Processes wherein the elemental halogen is derived from an initial mixture which contains lithium, sodium, potassium, rubidium, cesium, magnesium, calcium, strontium or barium.

**505** This subclass is indented under subclass 504. Processes wherein a substance is formed in a liquid or slurry, which substance is insoluble therein and can be or is separated from the liquid and the other materials which remain soluble in the liquid; or wherein the composition of the liquid is changed so that one part of the mixture becomes insoluble therein.

**506** This subclass is indented under subclass 500. Processes which include the step of reacting a compound of sulfur with the halide of lithium, sodium, potassium, cesium or rubidium.

**507** This subclass is indented under subclass 500. Processes in which a hydrogen halide or an ammonium halide is utilized as a reactant.

SEE OR SEARCH THIS CLASS, SUBCLASS:

502, for a process of preparing elemental halogen by catalytically reacting the hydrogen or ammonium halide.

**508** This subclass is indented under the class definition. Products and processes wherein the product is either selenium or tellurium, or a compound thereof.

SEE OR SEARCH CLASS:

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing Se or Te.

**509** This subclass is indented under subclass 508. Products and processes wherein the product is a binary compound which contains only one element in addition to the selenium or tellurium.

**510** This subclass is indented under subclass 508. Products and processes wherein the product is elemental selenium or tellurium.

**511** This subclass is indented under the class definition. Products or processes wherein the product is sulfur or a compound thereof.

**SEE OR SEARCH CLASS:**

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing sulfur, halogen, nitrogen, and metals.

**512.1 Oxygen containing:**

This subclass is indented under subclass 511. Products or processes wherein the product also contains oxygen.

**513** This subclass is indented under subclass 512.1. Products or processes wherein the product contains the peroxymonosulfate ( $\text{SO}_5^{2-}$ ) or the peroxydisulfate ( $\text{S}_2\text{O}_8^{2-}$ ) radical.

(1) Note. These radicals may also be identified as the permonosulfate or the perdisulfate, respectively.

**514** This subclass is indented under subclass 512.1. Products or processes wherein the compound contains the thiosulfate radical ( $\text{S}_2\text{O}_3^{2-}$ ).

**515** This subclass is indented under subclass 512.1. Products or processes wherein the product is a dithionite having the radical ( $\text{S}_2\text{O}_4^{2-}$ ).

(1) Note. Dithionite is frequently incorrectly termed hydrosulfite in the patents.

(2) Note. The term hyposulfite is generic to both dithionite and thiosulfate.

**516** This subclass is indented under subclass 515. Processes wherein an alloy of mercury is employed as a reactant in the process of forming a dithionite.

**517** This subclass is indented under subclass 512.1. Products or processes wherein the compound also contains both a metal and the ammonium ( $\text{NH}_4^+$ ) radical in addition to sulfur and oxygen.

(1) Note. Examples of the compounds included in this subclass are  $\text{K NH}_4\text{SO}_4$ ,  $(\text{NH}_4)_2\text{H}_2\text{ZrO}(\text{SO}_4)_3$  and  $5\text{K}_2\text{SO}_4(\text{NH}_4)_2\text{SO}_4$ .

(2) Note. Many of the ammonium and metal containing compounds belong to the class known as alums which are double salts of the general formula  $\text{M}'\text{M}''(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$  where  $\text{M}'$  may be certain univalent cations (e.g., Na, K,  $\text{NH}_4^+$ , Li, Ag, etc.) and  $\text{M}''$  may be certain trivalent cations (e.g., Al, Ga, Ti, Fe, Cr, etc.).

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

114, for recovery of compounds containing ammonium and aluminum where the starting material is a mixture or an ore.

**518** This subclass is indented under subclass 512.1. Products or processes, wherein the compound contains two or more different metals in addition to sulfur and oxygen.

(1) Note. Examples of the compounds included in this subclass are  $\text{K}_2\text{SO}_4\text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ ,  $\text{Na}_2\text{Al}_2(\text{SO}_4)_4$ , and  $\text{PbS BaO}$ .

(2) Note. Many of the plural metal containing compounds are known as alums, see (2) Note in subclass 517 for description of these compounds.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

117, for processes of treating mixtures to obtain a plural metal compound containing both oxygen and sulfur.

- 519** This subclass is indented under subclass 512.1. Products or processes wherein the compound contains the bisulfite or acid sulfite radical ( $\text{HSO}_3^-$ ).
- 519.2 Sulfite:**  
This subclass is indented under subclass 512.1. Products and processes wherein the compound is a sulfite; i.e., includes a ( $\text{SO}_3^{2-}$ ) radical.
- 520** This subclass is indented under subclass 512.1. Products or processes wherein the compound contains the bisulfate or acid sulfate radical ( $\text{SO}_4^{2-}$ ).
- 521** This subclass is indented under subclass 512.1. Products or processes in which the compound is ternary and consists of sulfur, oxygen and hydrogen only.
- 522** This subclass is indented under subclass 521. Products or processes in which the ternary compound is sulfuric acid ( $\text{H}_2\text{SO}_4$ ).
- (1) Note. This subclass provides for sulfuric acid ( $\text{H}_2\text{SO}_4$ ) including fuming sulfuric acid which is sometimes termed oleum or Nordhausen acid for which sometimes the formula  $\text{H}_2\text{S}_2\text{O}_7$  may be designated. However, this compound is actually  $\text{H}_2\text{SO}_4$  with  $\text{SO}_3$  dissolved therein and is classified in this subclass.
- 523** This subclass is indented under subclass 522. Processes in which during the manufacture of the sulfuric acid a compound of nitrogen is used as a catalyst or as a reactant, or is present as an impurity which requires removal.
- 524** This subclass is indented under subclass 523. Processes wherein sulfuric acid is produced from sulfur dioxide oxygen (air) and water or steam by means of nitrogen oxides (catalysts or reactants) in leaden chambers.
- (1) Note. The complete lead chamber process involves production of sulfur dioxide by burning sulfur or sulfur compounds. Sulfuric acid is produced in the lead chamber from the sulfur dioxide, oxygen (air), and water or steam by means of nitrogen oxides (catalysts or reactants). The gases leaving the reaction chamber contain practically the entire quantity of nitrogen oxides which have brought about the oxidation of  $\text{SC}_2$  to  $\text{SO}_3$ . These nitrogen oxides are recovered by absorption in  $\text{H}_2\text{SO}_4$  in so called Gay-Lussac towers. The nitrous sulfuric acid produced in these towers is conveyed to the beginning of the system where it is denitrated in so called Glover towers by means of the entering hot gases containing sulfur dioxide.
- 525** This subclass is indented under subclass 522. Processes wherein at least one of the starting materials is a mixture having an organic or carbonaceous impurity therein.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
531, for a process of purifying sulfuric acid of an impurity which is not an organic material or carbonaceous in nature; see (1) Note in subclass 226 for structural requirements of an organic substance.
- 526** This subclass is indented under subclass 525. Processes wherein the pressure on the mixture of acid and impurities is caused to be increased to greater than atmospheric or is caused to be decreased below atmospheric.
- (1) Note. These processes necessitate use of an autoclave or enclosed chamber. If the mixture is merely contacted with a gas which is then free to expand classification is in subclass 528 below.
- 527** This subclass is indented under subclass 525. Processes wherein an organic compound is added to the impure mixture.
- (1) Note. Examples of the organic additives are: solvent oils for dissolving impurities, fatty acids to reduce foaming, etc.
- (2) Note. See (1) Note in subclass 226 for structural requirements of an organic compound.



- 528** This subclass is indented under subclass 525. Processes including the step of bringing the mixture into contact with an external source of gas or steam.
- (1) Note. This subclass provides for processes wherein gas is bubbled through or blown against the mixture. However, it does not include processes wherein mere contact with atmospheric air is made nor wherein the only contact is with vapors rising from the mixture.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
526, for similar processes where the mixture is under pressure of vacuum.
- 529** This subclass is indented under subclass 522. Processes wherein the pressure on the reactants or sulfuric acid is caused to be increased to above atmospheric or to be decreased to below atmospheric, or water vapor from an external source is caused to contact the reactants or acid.
- (1) Note. Included under this definition is the step of causing the water vapor to discharge against the surface of the reactants or acid or of providing an atmosphere of water vapor above the reactants or acid.
- 530** This subclass is indented under subclass 522. Processes wherein one of the reactants or impurities is a compound of metal and the sulfate radical ( $\text{SO}_4^{2-}$ ).
- 531** This subclass is indented under subclass 522. Processes which include the removal or separation of impurities present in the reactants or in the acid.
- (1) Note. For the purposes of this subclass merely concentrating or dehydrating the acid to make the ratio of  $\text{H}_2\text{SO}_4$  to  $\text{H}_2\text{O}$  higher is not considered purification.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
523, for sulfuric acid making or purifying processes which may involve a nitrogen containing impurity.  
525, for sulfuric acid making or purifying processes wherein the original mixture includes an organic or carbonaceous impurity.
- 532** This subclass is indented under subclass 512.1. Products or processes wherein the compound is sulfur trioxide ( $\text{SO}_3$ ).
- 533** This subclass is indented under subclass 532. Processes wherein a catalyst is employed in a reaction.
- SEE OR SEARCH CLASS:  
502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 100+ for specific catalysts.
- 534** This subclass is indented under subclass 533. Processes wherein a second different and distinct catalyst is employed in series with the first catalyst, or wherein a substance which increases the efficiency of the catalyst is utilized.
- 535** This subclass is indented under subclass 535. Processes wherein the catalyst or its support includes oxygen, vanadium, and another metal.
- 536** This subclass is indented under subclass 533. Processes wherein the catalyst is, or contains, platinum.
- SEE OR SEARCH CLASS:  
502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 100+ for specific catalysts.
- 537** This subclass is indented under subclass 536. Processes wherein the platinum catalyst is spread on or is supported by a sulfate ( $\text{SO}_4^{2-}$ ) or asbestos substance.

- (1) Note. The carrier is usually for the purpose of extending the surface of the catalyst.
- SEE OR SEARCH CLASS:  
502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 100+ for specific catalysts.
- 538** This subclass is indented under subclass 533. Processes wherein the catalyst contains oxygen, usually as the oxide of a metal.
- SEE OR SEARCH CLASS:  
502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 100+ for specific catalysts.
- 539** This subclass is indented under subclass 512.1. Products or processes in which the compound is sulfur dioxide ( $\text{SO}_2$ ).
- 540** This subclass is indented under subclass 539. Processes which include as the initial feedstock sludge or other waste material resulting from the acid treatment of a substance.
- (1) Note. Many of the patents herein use a sludge which results from the acid treatment of an organic substance (e.g., paper).
- 541.1 Utilizing metal sulfate as reactant:**  
This subclass is indented under subclass 539. Processes which include the step of using sulfate of metal as a reactant.
- 541.4 Ammonium sulfate:**  
This subclass is indented under subclass 541.1. Processes which include the step of using sulfate of ammonium as a reactant.
- 542** This subclass is indented under subclass 539. Processes including the step of causing a compound of sulfur to be combusted with a flame or to be heated at high temperature or to be oxidized by heat in a current of air.
- 543** This subclass is indented under subclass 539. Processes including the step of causing the element sulfur to be combusted with a flame.
- 544** This subclass is indented under subclass 512.1. Products or processes wherein the compound contains the sulfate radical ( $\text{SO}_4^{2-}$ ).
- (1) Note. Included under this definition is a compound which contains another negative ion in addition to the sulfate radical, e.g., basic lead sulfate ( $\text{PbSO}_4 \cdot \text{PbO}$ ). See search note below compounds containing different positive ions.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
517, for products, or processes of making such products containing sulfur, oxygen and a metal and ammonium.  
518, for a product containing sulfur, oxygen and two different metals.
- 545** This subclass is indented under subclass 544. Products or processes wherein the compound contains the ammonium ion ( $\text{NH}_4^+$ ).
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
517, for a compound, or process of making the compound, which contains a metal in addition to the ammonium ( $\text{NH}_4^+$ ) radical and the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- 546** This subclass is indented under subclass 545. Processes wherein a compound containing the thiocyanate ( $\text{CNS}^-$ ) radical is reacted or decomposed to form the product.
- 547** This subclass is indented under subclass 545. Processes wherein a sulfite ( $\text{SO}_3^{2-}$ ) or a bisulfite ( $\text{HSO}_3^-$ ) is one of the reactants employed to form the compound.
- 548** This subclass is indented under subclass 545. Processes wherein a metal sulfate ( $\text{SO}_4^{2-}$ ) is one of the reactants employed.
- 549** This subclass is indented under subclass 545. Processes wherein sulfuric acid ( $\text{H}_2\text{SO}_4$ ) is one of the reactants.

- chemically forming a compound having the  $\text{SO}_4^{2-}$  radical.
- 550** This subclass is indented under subclass 549. Processes wherein sulfuric acid is contacted with waste gases containing ammonia to form ammonium sulfate.
- 551** This subclass is indented under subclass 544. Products or processes wherein the compound contains lithium, sodium, potassium, rubidium or cesium.
- 552** This subclass is indented under subclass 551. Processes which include the step of reacting a chloride.
- 553** This subclass is indented under subclass 551. Processes wherein at least some of the water is removed from a hydrated compound containing the alkali metal and the sulfate ( $\text{SO}_4^{2-}$ ) radical.
- 554** This subclass is indented under subclass 544. Products or processes wherein the compound contains magnesium, calcium, strontium or barium.
- 555** This subclass is indented under subclass 554. Products or processes in which the metal is calcium.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
171, for processes of calcining gypsum which is primarily calcium dihydrate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) to obtain plaster of paris which is primarily calcium hemihydrate ( $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$ ).
- 556** This subclass is indented under subclass 544. Products or processes wherein the compound contains aluminum.
- (1) Note. Included under this definition are all forms of aluminum sulfate, as for example the hydroxy sulfate or the hydrosulfate, etc.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
128, for processes of treating mixtures to obtain an aluminum sulfate, including the steps of (1) forming an insoluble substance in a liquid, and (2)
- 557** This subclass is indented under subclass 544. Products or processes in which the compound contains copper.
- 558** This subclass is indented under subclass 544. Products or processes wherein the compound contains iron.
- 559** This subclass is indented under subclass 544. Products or processes wherein the compound contains lead.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
97, for processes of treating mixtures to recover lead sulfate and in which the process includes the step of volatilizing lead.
- 560** This subclass is indented under subclass 511. Products or processes wherein the compound consists of sulfur, hydrogen, and metal.
- (1) Note. These compounds are variously designated as hydrosulfides in the more recent patents and as sulfhydrates in other documents.
- 561.1 Binary compound:**  
This subclass is indented under subclass 511. Products or processes in which the compound consists of sulfur and only one additional element.
- 562** This subclass is indented under subclass 561.1. Products or processes wherein the compound includes associated sulfur in addition to the amount normally present in a sulfide.
- (1) Note. For example, when additional sulfur is associated with sodium sulfide ( $\text{Na}_2\text{S}$ ) under certain conditions sodium polysulfide ( $\text{Na}_2\text{S}_5$ ) is formed.
- (2) Note. It should be noted that a sulfide which merely has a plurality of sulfur atoms therein is not necessarily a polysulfide, as in aluminum sulfide ( $\text{Al}_2\text{S}_3$ ). This compound has only the normal amount of sulfur to combine with

- the aluminum to form the aluminum sulfide.
- 563** This subclass is indented under subclass 561.1. Products or processes in which the binary compound is hydrogen sulfide ( $\text{H}_2\text{S}$ ).
- 564** This subclass is indented under subclass 563. Processes including the step of employing a catalyst during a reaction in which the product is formed.
- SEE OR SEARCH CLASS:  
502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 100+ for specific catalysts.
- 565** This subclass is indented under subclass 561.1. Processes including the step of reacting elemental sulfur in making the product.
- 566** This subclass is indented under subclass 561.1. Processes including the step of using a compound having the  $\text{SO}_4^{2-}$  radical as a reactant.
- 566.1 Sulfide of Cd, Zn or Hg:**  
This subclass is indented under subclass 561.1. Product or process in which the compound is a sulfide of zinc, cadmium or mercury.
- 566.2 Sulfide of alkali metal:**  
This subclass is indented under subclass 561.1. Product or process in which the compound is a sulfide of an alkali metal.
- 566.3 Sulfide of alkaline earth metal:**  
This subclass is indented under subclass 561.1. Product or process in which the compound is a sulfide of an alkaline earth metal.
- 567.1 Elemental sulfur:**  
This subclass is indented under subclass 511. Products and processes wherein the product is sulfur in elemental form.
- 568** This subclass is indented under subclass 567.1. Processes which include the step of forming a compound that contains chlorine.
- 569** This subclass is indented under subclass 567.1. Processes which include the step of reducing the valence of the sulfur in sulfur dioxide from +4 with a material containing carbon to form the elemental sulfur having a valence of zero.
- 570** This subclass is indented under subclass 569. Processes which include the step of employing a catalyst in the reduction reaction.
- 571** This subclass is indented under subclass 567.1. Processes which include the step of using as a reactant a compound having the sulfide ( $\text{S}_2$ ) ion.
- (1) Note. The sulfide may be provided from any source, e.g., ores (pyrites), gas streams, etc.
- 572** This subclass is indented under subclass 571. Processes which include the step of reacting water in its vapor or gaseous state with the sulfide to form the compound hydrogen sulfide ( $\text{H}_2\text{S}$ ) as an intermediary in the production of sulfur.
- 573.1 Hydrogen sulfide:**  
This subclass is indented under subclass 571. Subject matter in which the sulfide reacted is hydrogen sulfide.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
210+, for a process for treating a feed gas to remove a constituent therefrom when there is no recovery of a desired material stemming from that component, even though a hydrogen sulfide component of the feed gas is converted to elemental sulfur and its recovery requires further processing, that is, the "more comprehensive claim" rule does not apply within a class.  
220+, for a process for treating a feed gas containing hydrogen sulfide to modify or remove this component without recovery of hydrogen or sulfur-containing material therefrom.  
572, for a process in which a sulfide compound is reacted with water vapor to form hydrogen sulfide which is then reacted to produce sulfur.

- impurities or that provided by water of reaction.
- 574.1 With sulfur dioxide:**  
This subclass is indented under subclass 573.1. Processes including a step of reacting the hydrogen sulfide with sulfur dioxide.
- 574.2 In inorganic liquid:**  
This subclass is indented under subclass 574.1. Processes where the reacting step takes place in liquid media without an organic carbon compound as a principle constituent; e.g., in water.
- 575** This subclass is indented under subclass 574.1. Processes including the step of utilizing an organic compound as a solvent or absorbent.
- (1) Note. See (1) Note in subclass 226 for the structural requirements of an organic material.
- 576** This subclass is indented under subclass 574.1. Processes which are carried out in the presence of a catalyst, its carrier or a promoter thereof, which contains aluminum or silica.
- 576.2 With specified procedure for sulfur recovery or specified conditions for producing sulfur in more recoverable form:**  
This subclass is indented under subclass 573.1. Subject matter which includes a step for recovering elemental sulfur beyond merely "removing" or "recovering" the sulfur or in which conditions other than mere temperature regulation are specified for obtaining elemental sulfur in more recoverable form, for example, by employing an additive to assure sulfur in crystalline form.
- SEE OR SEARCH CLASS:  
23, Chemistry: Physical Processes, subclass 293 and 308 for processes of acting upon sulfur without a chemical reaction.
- 576.4 By reacting gaseous feed stream with liquid aqueous mixture:**  
This subclass is indented under subclass 573.1. Subject matter in which a hydrogen sulfide-containing feed gas is contacted with a liquid which contains a significant amount of water, elemental sulfur being formed in such mixture.
- (1) Note. A "significant" amount of water is taken to mean more than commercial
- 576.5 Transition metal-containing mixture:**  
This subclass is indented under subclass 576.4. Subject matter in which the water-containing mixture also contains a metal, in free or combined form, belonging to the transition group of metals.
- (1) Note. For the definition of a transition metal, see (1) Note in the definition of Class 428, subclass 655.
- 576.6 Chelated or sequestered transition metal:**  
This subclass is indented under subclass 576.5. Subject matter in which the transition metal is dissolved in the form of a complex which retards precipitation of that metal from solution.
- 576.7 Organic compound-containing:**  
This subclass is indented under subclass 576.5. Subject matter in which the water-containing mixture also contains an organic compound.
- 576.8 By reacting gaseous feed with gas containing free oxygen:**  
This subclass is indented under subclass 573.1. Subject matter in which a hydrogen sulfide-containing feed gas is directly contacted and mixed with a gas containing oxygen in uncombined form, elemental sulfur being thereby formed, including a process wherein such gases simultaneously contact a solid catalyst.
- 577** This subclass is indented under subclass 571. Processes in which the sulfide is that of a metal and is reacted with sulfur dioxide (SO<sub>2</sub>).
- 578.1 Purifying crude sulfur:**  
This subclass is indented under subclass 567.1. Products or processes including recovering or separating sulfur from impurities mixed therewith.
- 578.2 From ore:**  
This subclass is indented under subclass 578.1. Products or processes wherein the crude sulfur is obtained from a natural mineral found mixed with earthy matter.

**578.4 From liquid or solid compound:**

This subclass is indented under subclass 567.1. Processes in which the sulfur is obtained from a compound that is in a liquid or solid-state.

**579** This subclass is indented under the class definition. Products or processes wherein the product is oxygen or a compound thereof.

**SEE OR SEARCH CLASS:**

588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the destruction or containment of hazardous or toxic waste containing oxygen, sulfur, halogen, nitrogen, and metals.

**580.1 Water:**

This subclass is indented under subclass 579. Products and processes wherein the compound is water ( $H_2O$ ).

**580.2 Heavy water:**

This subclass is indented under subclass 580.1. Products and processes wherein the water is in its heavy form; e.g.,  $D_2O$  where D is a deuterium isotopic hydrogen mass=2 or  $H_2^{18}O$  where  $^{18}O$  is an oxygen mass=18.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

249, for heavy water that contains tritium and exhibits nuclear disintegration with emission of radioactive particles.

**SEE OR SEARCH CLASS:**

376, Induced Nuclear Reactions: Processes, Systems, and Elements, for a combination of nuclear reaction and tritium removal.

**581** This subclass is indented under subclass 579. Products or processes wherein the compound is a superoxide containing the ( $O_2^-$ ) radical, or is ozone ( $O_3$ ).

**582** This subclass is indented under subclass 579. Products or processes in which the compound is a peroxide containing the ( $O_2^{2-}$ ) radical.

**583** This subclass is indented under subclass 582. Products or processes wherein the peroxide contains a metal of the alkaline earth group (magnesium, calcium, strontium or barium).

**584** This subclass is indented under subclass 582. Products or processes wherein the compound is hydrogen peroxide ( $H_2O_2$ ).

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

272+, for hydrogen peroxide with a stabilizer.

**SEE OR SEARCH CLASS:**

23, Chemistry: Physical Processes, subclasses 293+ for processes for purifying hydrogen peroxide and aqueous solutions thereof not involving a chemical reaction and not otherwise provided for.  
204, Chemistry: Electrical and Wave Energy, appropriate subclasses, for processes for preparing hydrogen peroxide which involve the use of electrical or wave energy.

**585** This subclass is indented under subclass 584. Processes wherein the preparation of hydrogen peroxide includes the use of permonosulfuric acid ( $H_2SO_5$ ) or perdisulfuric acid ( $H_2S_2O_8$ ) or the corresponding sulfate salts.

(1) Note. These acids may also be identified as peroxymonosulfuric or peroxydisulfuric, respectively.

(2) Note. Included under this definition are processes describing the distillation of persulfuric acid or a persulfate compound to produce hydrogen peroxide. However, there must first be a hydrolysis with water to form hydrogen peroxide which is then distilled from the mixture.

**SEE OR SEARCH CLASS:**

203, Distillation: Processes, Separatory, appropriate subclasses, for specific distillation processes for separating hydrogen peroxide from a mixture.

**586** This subclass is indented under subclass 584. Processes wherein the preparation of hydrogen peroxide includes the use of an inorganic peroxide compound (e.g.,  $\text{Na}_2\text{O}_2$ ,  $\text{BaO}_2$ , etc.).

**587** This subclass is indented under subclass 584. Processes wherein the preparation of hydrogen peroxide includes the use of an organic compound as reactant.

**588** This subclass is indented under subclass 587. Processes wherein the preparation of hydrogen peroxide includes the step of oxidizing a reactant comprising a hydroquinone or an anthraquinone, or substituted forms thereof.

- (1) Note. Included in this subclass are disclosures which describe cyclic processes in which hydroquinone or anthrahydroquinone is first oxidized to form hydrogen peroxide and a quinone or anthraquinone. The latter two compounds are then reduced to the corresponding hydroquinone or anthrahydroquinone which is then oxidized to again form the hydrogen peroxide and the quinone or hydroquinone.

SEE OR SEARCH CLASS:

552, Organic Compounds, subclasses 208+ for processes for reducing anthroquinone to anthroahydrouquinone; subclasses 291+ and 293+ for processes for reducing quinone to hydroquinone.

**589** This subclass is indented under subclass 588. Processes in which a reactant is dissolved in a solvent comprising an ester.

**590** This subclass is indented under subclass 588. Processes in which a reactant is dissolved in a solvent comprising alcohol.

**591** This subclass is indented under subclass 587. Processes in which the preparation of hydrogen peroxide includes the step of oxidizing an alcohol or a hydrocarbon.

**592** This subclass is indented under subclass 579. Products or processes wherein the product is a compound which contains oxygen and metal.

- (1) Note. In this and some indented subclasses there will be found older patents in which the term "peroxide" obviously means dioxide, since the required  $\text{O}_2^{2-}$  for a peroxide is not present, and classification in subclasses 582 and 583 is therefore precluded.

SEE OR SEARCH THIS CLASS, SUBCLASS:

581, for superoxides which contains a metal.  
582, and 583, for peroxides which contain a metal.

**593** This subclass is indented under subclass 592. Products or processes wherein the compound contains two or more metals or has a metal and the ammonium ( $\text{NH}_4^+$ ) radical.

**594** This subclass is indented under subclass 582. Products or processes which comprise iron, cobalt or nickel.

SEE OR SEARCH THIS CLASS, SUBCLASS:

127, for processes of treating mixtures to obtain aluminum hydroxide or hydrate of aluminum, including the steps of (1) forming an insoluble substance in a liquid and, (2) chemically forming an hydroxide or a hydrate.

**595** This subclass is indented under subclass 593. Products or processes which comprises chromium.

SEE OR SEARCH THIS CLASS, SUBCLASS:

58, for processes of treating mixtures to obtain a plural metal compound wherein one of the metals is chromium, including the step of forming an insoluble substance in a liquid.

**596** This subclass is indented under subclass 595. Products or processes wherein the compound also contains the ammonium ( $\text{NH}_4^+$ ) radical or a metal of the alkali or a metal of the alkali or the alkaline earth groups.

- 597** This subclass is indented under subclass 596. Products or processes wherein the compound is in the form of a dichromate ( $\text{Cr}_2\text{O}_{72}$ ).
- 598** This subclass is indented under subclass 593. Products or processes wherein the compound contains titanium.
- 599** This subclass is indented under subclass 593. Products or processes wherein the compound contains maganese.
- 600** This subclass is indented under subclass 593. Products or processes wherein the compound contains aluminum.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
119+, for processes of treating mixtures to obtain an alkali metal aluminate.
- 601** This subclass is indented under subclass 593. Products or processes wherein the compound contains arsenic.
- 602** This subclass is indented under subclass 601. Products or processes in which the arsenic has a valence of +5 and is in the form of arsenate [i.e., metal arsenate ( $\text{AS O}_3$ ), ortho arsenate ( $\text{AsO}_4^{3-}$ ) and pyroarsenate ( $\text{AS}_2\text{O}_7$ )].
- 603** This subclass is indented under subclass 602. Products or processes wherein the arsenate contains lead as the other metal.
- 604** This subclass is indented under subclass 592. Products or process in which the metal is copper, silver or gold (i.e., Group I B).
- 605** This subclass is indented under subclass 592. Products or processes in which the metal is from Group VII B (i.e., manganese, technetium or rhenium).
- 606** This subclass is indented under subclass 592. Products or processes wherein the metal is chromium, molybdenum or tungsten (Group VIB).
- 607** This subclass is indented under subclass 606. Products or processes wherein the metal is chromium.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
595, for compound which contain oxygen chromium and another metal or ammonium.
- 608** This subclass is indented under subclass 592. Products or processes wherein the metal in titanium, zirconium or hafnium (Group IV B).
- 609** This subclass is indented under subclass 608. Products or processes wherein the metal is titanium and the compound is the monoxide ( $\text{TiO}$ ) or the sesquioxide ( $\text{Ti}_2\text{O}_3$  or  $\text{Ti}(\text{OH})_3$ ).
- 610** This subclass is indented under subclass 608. Product or products or processes wherein ,the, compound is titanium dioxide ( $\text{TiO}_2$ ).
- 611** This subclass is indented under subclass 610. Processes wherein the preparation of titanium dioxide includes the use of a titanium halide reactant.
- 612** This subclass is indented under subclass 611. Processes wherein the reactant is a titanium tetrahalide (e.g.,  $\text{TiF}_4$ ,  $\text{TiBr}_4$ , etc.).
- 613** This subclass is indented under subclass 612. Processes wherein the tetrahalide is oxidized by a gas.
- 614** This subclass is indented under subclass 613. Processes wherein the oxidation takes place in a fluidized bed.
- 615** This subclass is indented under subclass 610. Processes in which the preparation of titanium dioxide includes the use of titanium sulfate as a reactant.
- 616** This subclass is indented under subclass 615. Processes in which an acid is associated with the process in any manner (e.g., as a solvent, as a reactant, etc.).
- 617** This subclass is indented under subclass 592. Products or processes wherein the metal is antimony, bismuth or arsenic (Group V A).
- (1) Note. Arsenic is defined as a metal for the purpose of this class.



- 618** This subclass is indented under subclass 592. Products or processes wherein the metal is germanium, tin or lead (Group IV A).
- 619** This subclass is indented under subclass 618. Products or processes wherein the metal is lead.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
97, for processes of treating mixtures to recover lead wherein the lead is recovered as lead oxide, by volatilization.
- SEE OR SEARCH CLASS:  
429, Chemistry: Electrical Current Producing Apparatus, Product, and Process, subclasses 225+ for lead electrodes for batteries.
- 620** This subclass is indented under subclass 619. Processes including the step of utilizing lead in the elemental or metallic form as a reactant.
- 621** This subclass is indented under subclass 620. Processes in which the elemental lead is in the fused or liquid state.
- 622** This subclass is indented under subclass 592. Products or processes wherein the metal is zinc.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
101+, for processes of treating mixtures to obtain a zinc containing compound, including the step of forming an insoluble substance in a liquid.
- 623** This subclass is indented under subclass 622. Processes which include the step of causing a normally solid or liquid substance comprising zinc in either its element or compound form to pass into a gas or vapor, see Glossary.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
107+, for processes of treating mixtures to obtain a zinc-oxy compound, including the step of volatilizing a Group II B metal.
- 624** This subclass is indented under subclass 592. Products or Processes wherein the metal is aluminum, gallium, thallium or indium (Group III A) or beryllium.
- 625** This subclass is indented under subclass 624. Products or processes wherein the metal is aluminum.
- 626** This subclass is indented under subclass 625. Processes in which the preparation of the aluminum compound includes the use of an acid in any manner (e.g., as a solvent, as a reactant, etc.).
- 627** This subclass is indented under subclass 625. Processes in which the preparation of the compound includes a reaction between aluminum in elemental form and water in the liquid or vapor form.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
657, for processes of making hydrogen by reacting water and a metal.
- 628** This subclass is indented under subclass 625. Products or processes wherein the compound is alumina( $Al_2O_3$ ) and in the process has become "activated" or has had its pore size adjusted for use in a catalyst or a sorbent.
- 629** Products or processes under 625 wherein the compound is aluminum hydroxide, ( $Al(OH)_3$ ).
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
127, for processes of treating mixtures to obtain aluminum hydroxide or hydrate of aluminum, including the steps of (1) forming an insoluble substance in a liquid and, (2) chemically forming an hydroxide or a hydrate.
- 630** This subclass is indented under subclass 625. Processes in which preparation of the aluminum compound includes the use of carbon or a compound thereof as a reactant.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

137, for processes of reducing an ore with carbon to obtain an aluminum containing compound.

- 631** This subclass is indented under subclass 625. Processes in which preparation of the aluminum compound includes the use of a nitrogen compound as a reactant.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

626, for processes wherein the nitrogen containing compound reactant is nitric acid.

- 632** This subclass is indented under subclass 592. Products or processes wherein the metal is iron.

(1) Note. Ferriferrous oxide ( $\text{Fe}_3\text{O}_4$ ) may be merely a mixture of one part ferrous oxide ( $\text{FeO}$ ) and one part ferric oxide ( $\text{Fe}_2\text{O}_3$ ). Such a compound ( $\text{Fe}_3\text{O}_4$ ) will be considered a compound for this Class 423 and will be classified in this subclass 632 and not in subclass 633 below. However, if the ratio of the  $\text{FeO}$  to the  $\text{Fe}_2\text{O}_3$  is other than one-to-one (stoichiometric) or if a range is given, the product will be considered a composition and the patent will be classified in the appropriate composition class.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

151, for making magnetic  $\text{Fe}_3\text{O}_4$  from impure starting materials such as ores or waste products.

SEE OR SEARCH CLASS:

106, Compositions: Coating or Plastic, subclasses 456+ for a pigment composition which may comprise a mixture of ferrous and ferric oxides, in which the oxides are present in other than one-to-one proportion (stoichiometric) or in which mixture one of the oxide is stated to be present in a range of parts (between 1 part and 3 parts, etc.).

252, Compositions, subclasses 62.51+, especially 62.56, for a magnetic composition, which may comprise a mixture of ferrous and ferric oxides, in which the oxides are present in other than a one-to-one proportion (stoichiometric) or in which in the mixture one of the oxides is stated to be present in a range of parts (between 1 part and 3 parts, etc.).

501, Compositions: Ceramic, subclasses 94+ for ceramic refractory compositions which may comprise a mixture of ferrous and ferric oxides, in which the oxides are present in other than a one-to-one proportion (stoichiometric) or in which mixture one of the oxides is stated to be present in a range of parts (between 1 part and 3 parts, etc.).

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, subclasses 100+ for specific catalysts.

- 633** This subclass is indented under subclass 632. Products or processes wherein the compound is ferric oxide ( $\text{Fe}_2\text{O}_3$ ).

SEE OR SEARCH THIS CLASS, SUB-CLASS:

632, for ferriferrous oxide ( $\text{Fe}_3\text{O}_4$ ) composed of a one to one mixture of ferrous oxide ( $\text{FeO}$ ) and ferric oxide ( $\text{Fe}_2\text{O}_3$ ) and see (1) Note thereunder.

- 634** This subclass is indented under subclass 633. Products or processes wherein the ferric oxide is described as having cubic or gamma crystal-line structure.

- 635** This subclass is indented under subclass 592. Products or processes wherein the metal is magnesium, calcium, strontium, or barium.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

164, for processes of treating mixtures to obtain a hydrate or hydroxide of an alkaline earth metal, including the steps of (1) forming an insoluble substance in a liquid and (2) chemically forming a hydrate or a hydroxide.

- 636** This subclass is indented under subclass 635. Processes for making the compound.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
158+, for processes of treating mixture to obtain an alkaline earth metal oxygen containing compound, including the step of forming an insoluble substance in a liquid.
- 637** This subclass is indented under subclass 636. Processes in which a carbonate ( $\text{CO}_3^{2-}$ ) is utilized as a reactant.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
173+, for processes of treating mixtures to obtain alkaline earth metal containing oxides.
- 638** This subclass is indented under subclass 636. Processes in which a compound of sulfur is utilized as a reactant.
- 639** This subclass is indented under subclass 636. Processes in which a compound of nitrogen or a halogen is utilized as a reactant.
- 640** This subclass is indented under subclass 636. Processes in which lime ( $\text{CaO}$ ) is mixed with water to form the hydrate.
- 641** This subclass is indented under subclass 592. Products or processes wherein the metal is lithium, sodium, potassium, rubidium or cesium.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
179+, for methods of obtaining alkali metal containing compounds wherein the starting starting materials are impure, i.e., mixtures.
- 642** This subclass is indented under subclass 641. Processes in which preparation of the compound includes the use of a compound of sulfur as a reactant.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
183, for processes of treating mixtures to regenerate hydroxide solutions by reacting a sulfur containing compound to form an alkali metal hydroxide.
- 643** This subclass is indented under subclass 641. Processes in which preparation of the compound includes the use of a compound of nitrogen or a halogen as a reactant.
- 644** This subclass is indented under the class definition. Products or processes wherein the product is hydrogen or a compound thereof.
- 645** This subclass is indented under subclass 644. Products or processes wherein the compound contains hydrogen and only one additional element.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
347, for binary compounds which contains only hydrogen and silicon.
- 646** This subclass is indented under subclass 645. Products or processes wherein the additional element is an alkali metal.
- 647** This subclass is indented under subclass 645. Products or processes wherein the additional element is an alkaline earth metal.
- 647.7 Deuterium-containing:**  
This subclass is indented under subclass 644. Subject matter concerned with a heavier, non-radioactive isotope of hydrogen; usually, the product is a hydrogen stream enriched in deuterium.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
249, for a tritium compound or a method for recovering tritium or a tritium compound.  
580.2, for deuterium oxide (heavy water), and a process of making.

**648.1 Elemental hydrogen:**

This subclass is indented under subclass 644. Subject matter wherein the product is hydrogen in elemental form.

**SEE OR SEARCH CLASS:**

- 48, Gas: Heating and Illuminating, sub-classes 197+ for the manufacture of elemental hydrogen in association with other gases for use as a fuel.
- 204, Chemistry: Electrical and Wave Energy, for production of elemental hydrogen by a process included therein, especially subclasses 157.4+ for the synthesis of hydrogen by wave energy (e.g., photolysis, sonic or shock waves, etc.).
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, for production of elemental hydrogen by a process included therein, especially subclasses 628+, for the synthesis of hydrogen by electrolysis.
- 252, Compositions, subclasses 372+, for the manufacture of elemental hydrogen, in association with other gases, for uses other than as a fuel, e.g., as a feedstock to a chemical reaction, etc.

**649** This subclass is indented under subclass 648.1. Processes including the conversion of ortho hydrogen to para hydrogen (i.e., protons of molecules spin in same or opposite directions, respectively or vice versa).

**650** This subclass is indented under subclass 648.1. Processes in which preparation of the hydrogen includes the step of decomposing a hydrocarbon (i.e., a compound consisting of only hydrogen and carbon).

**651** This subclass is indented under subclass 650. Processes in which a catalyst is utilized in the decomposition; see Glossary.

**652** This subclass is indented under subclass 651. Processes in which water is also decomposed.

**653** This subclass is indented under subclass 652. Processes wherein any material which is part of the catalyst (e.g., catalyst, promoter, support,

etc.), contains nickel in metallic or compound form.

**654** This subclass is indented under subclass 653. Processes comprising another metal in addition to nickel as part of the catalyst structure (e.g., catalyst, promoter, support, etc.).

**655** This subclass is indented under subclass 648.1. Processes in which preparation of the hydrogen includes the step of reacting water in any state with carbon monoxide.

**656** This subclass is indented under subclass 655. Processes wherein a catalyst containing the oxide of a metal is utilized.

**657** This subclass is indented under subclass 648.1. Processes in which preparation of the hydrogen includes the step of reacting water in any state or liquid water containing a solute with a metal or compound thereof.

**658** This subclass is indented under subclass 657. Processes wherein the metal is iron.

**658.2 By direct decomposition of binary compound; e.g., chemical storage, etc.:**

This subclass is indented under subclass 648.1. Subject matter wherein the elemental hydrogen is obtained directly from a compound of hydrogen containing only one other element, without intermediate transfer to a compound containing more than one other element.

(1) Note. The other member of the binary hydrogen compound need not enter the elementary state for the process to be considered "decomposition".

(2) Note. Where an alloy of two or more metals is hydrided and hydrogen is recovered from the hydride, the process is proper for placement in this subclass.

**SEE OR SEARCH CLASS:**

- 75, Specialized Metallurgical Processes, Compositions for Use Therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 228+ and 251+ for a metal powder composition chemically reactive with hydrogen to form a hydride or hydrides, which

- hydrided metal composition can readily yield back hydrogen.
- 206, Special Receptacle or Package, subclass 0.7 for a gas storage receptacle containing an "absorbent".
- 252, Compositions, subclass 188.25 and 188.26 for compositions chemically reactive with hydrogen to form a hydride or hydrides which hydrided composition can readily yield back hydrogen.
- 420, Alloys or Metallic Compositions, appropriate subclasses for such compositions chemically reactive with hydrogen to form a hydride or hydrides which yielded composition can readily yield back hydrogen.

**658.3 By reaction of impurities in a stream containing elemental hydrogen:**

Subject matter under subject 648.1 wherein a stream containing elemental hydrogen is enriched in hydrogen by the chemical reaction of other substances to remove them from the stream.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 248, for a method of chemically purifying a gaseous stream containing hydrogen where recovery of the hydrogen is not contemplated.

SEE OR SEARCH CLASS:

- 95, Gas Separation: Processes, for a process for enriching a hydrogen stream by nonchemical removal of impurities therefrom.

**658.5** This subclass is indented under the class definition. Processes for extracting, leaching or dissolving of a product not provided for above.

- (1) Note. This subclass is the locus for patents whose claims and disclosure are not limited to a particular product, i.e., inorganic compound or nonmetallic element provided for in Class 423.
- (2) Note. A patent in which the claims are not limited to extracting, leaching or dissolving a specific product will be classified on the basis of its disclosure as follows:

(a) If the disclosure includes a product for this class as well one provided for in another class (e.g., Class 260, etc.), the patent will be classified above in the appropriate subclass providing for the specific product and cross reference in this subclass 658.5, as well as in the other class, if appropriate.

(b) If the disclosure is limited to a product provided for in another class (e.g., Class 260 etc.), classification in the other class is proper.

(c) If the disclosure does not include a product provided for in Class 423, but includes a product provided for in each of a plurality of other classes (e.g., Class 208 and Class 260), patent is properly classified in this subclass 658.5 with appropriate cross references as required.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 8, 24, 54, 53, 70, 112, 139, 157, and 181, for processes utilizing liquid or liquid extraction to separate desired metallic compounds from mixtures.
- 20, 27, 68, 86, 98, 109, 131, 150, and 208, for processes utilizing leaching, washing, or dissolving to separate desired metallic compounds from mixtures.

SEE OR SEARCH CLASS:

- 208, Mineral Oils: Processes and Products, appropriate subclasses for extracting mineral oil fractions and subclasses 311+ for processes of extracting mineral oil to dissolve and remove desired portions therefrom.
- 210, Liquid Purification or Separation, subclass 632 and 633+ for a process purifying a liquid by solute or liquid extraction.
- 260, Chemistry of Carbon Compounds, appropriate subclasses for extracting particular compounds and subclass 705 for processes of general application for extracting carbon compounds.
- 585, Chemistry of Hydrocarbon Compounds, subclasses 833+, for a process of purifying a hydrocarbon by solvent extraction.

**659** This subclass is indented under the class definition. Subject matter not provided for in any of the preceding subclasses.

**700 ZEOLITE:**

This subclass is indented under the class definition. Products or processes of making wherein the product is zeolite.

- (1) Note. Included in this subclass are zeolites, as defined in Class 502, having ion exchange properties, generally represented by the following formula:  $0.8 - 1.0 M_2O : Y_2O_3 : n XO_2 : b H_2O$  where M is an ion exchangeable cation; X is an element of valence +4; Y is an element of valence +3; n is a number greater than 1; and b is the number of moles of water (typically in a range of 1-500). This class of compounds is considered to be particular enough so that the (13) Note in the main class definition does not apply, and these zeolite substances will be considered compounds for Class 423.

The rationale behind this consideration is that zeolites may be interpreted either as a range of values or as specifically defined values, though in a form of decimal or fractional amounts, these formulas designate a definite compound or complex. This class of compounds, zeolites, are considered products for Class 423, unless mixed with an additive whose function is not solely to perfect the product, see (6) Note of subclass 265.

- (2) Note. Zeolites include crystalline structures having an additional property of being molecular sieves, i.e., having a uniform pore size; however, carbon based "molecular sieves" such as graphite intercalation compounds, coals, and polymers are excluded from this subclass.
- (3) Note. The term "zeolite" has also been used to designate other substances such as organic resins which ion exchange with other substances; comments of (1) Note are intended to apply only to crystalline inorganic compounds.

SEE OR SEARCH THIS CLASS, SUBCLASS:

327.1+, for amorphous and layered aluminosilicates, clays, and feldspars.

SEE OR SEARCH CLASS:

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, appropriate subclasses for zeolites specifically structured to catalyze or sorb a component.

**701 Organic compound used to form zeolite:**

This subclass is indented under subclass 700. Processes wherein an organic compound is used in synthesizing the zeolite.

**702 Organic template used:**

This subclass is indented under subclass 701. Processes of making wherein the organic compound is used as an agent for directing crystal lattice synthesis of the zeolite.

**703 Mixed template:**

This subclass is indented under subclass 702. Processes wherein more than one compound is used together in directing synthesis of the zeolite crystal.

**704 Nitrogen containing:**

This subclass is indented under subclass 702. Processes wherein the template contains nitrogen.

**705 Amine:**

This subclass is indented under subclass 704. Processes wherein the template contains a compound having an amine grouping, i.e.,  $NR_3$ , wherein at least one of the R groups is an organic radical.

- (1) Note. Inclusive in this subclass are primary amines (aminos), secondary amines (imines), and tertiary amines (nitriles) all having an  $NR_3$  grouping wherein at least one of the R groups is an organic radical.

**706 Cyclic:**

This subclass is indented under subclass 705. Processes wherein the amine is a ringed compound.

- 707 Hydroxyl:**  
This subclass is indented under subclass 705. Processes wherein the amine contains a hydroxy radical (-OH) group.
- 708 Diamine:**  
This subclass is indented under subclass 705. Processes wherein the organic template contains two amine groups.
- 709 Seed used:**  
This subclass is indented under subclass 700. Processes wherein the zeolite is formed by providing a nucleus for zeolite crystal growth.
- 710 Aging to induce zeolite formation from inorganic mixture:**  
This subclass is indented under subclass 700. Processes wherein nuclei for the zeolite are allowed to form by passing of time during a period prior to crystallization.
- 711 With physical treatment:**  
This subclass is indented under subclass 710. Processes including application of force or energy during aging.
- 712 Synthesized from naturally occurring product:**  
This subclass is indented under subclass 700. Processes wherein the zeolite is grown from materials that were not artificially produced or synthesized.
- 713 Isomorphic metal substitution:**  
This subclass is indented under subclass 700. Processes wherein a structural analogue of zeolite is formed by substituting one or more elements into a zeolite crystal, e.g., partial or complete replacement of aluminum by silicon to form a silicon polymorph such as silicalite.
- (1) Note. This substitution may occur after or during zeolite synthesis.
- (2) Note. Not included in this subclass is precipitation of an element on a surface of the zeolite such as by ion exchange processes.
- SEE OR SEARCH CLASS:**  
210, Liquid Purification or Separation, subclasses 660+ for ion exchange processes.
- 714 Acid treatment:**  
This subclass is indented under subclass 713. Processes wherein zeolite structural analogues are formed by treatment with acid.
- 715 Halogen containing acid:**  
This subclass is indented under subclass 714. Process wherein the treatment is with an acid having a halogen element (e.g., HCl).
- 716 With change of synthesized zeolite morphology:**  
This subclass is indented under subclass 700. Processes wherein a synthesized zeolite of one structural type is converted to a different structural type.
- 717 Physical treatment:**  
This subclass is indented under subclass 716. Processes including using mechanical force or energy.
- 718 Structure defined by X-ray diffraction pattern:**  
This subclass is indented under subclass 700. Products wherein a zeolite structure is identified by a diffraction grating produced by an X-ray passing through it.
- (1) Note. Original patents in this subclass require an X-ray diffraction pattern referenced in the claim.
- END